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REPORT

OF A

GEOLOGICAL EXPLORATION

OF PART OF

IOWA, WISCONSIN, AND ILLINOIS,

MADE UNDER INSTRUCTIONS FROM THE

SECRETARY OF THE TREASURY OF THE UNITED STATES,

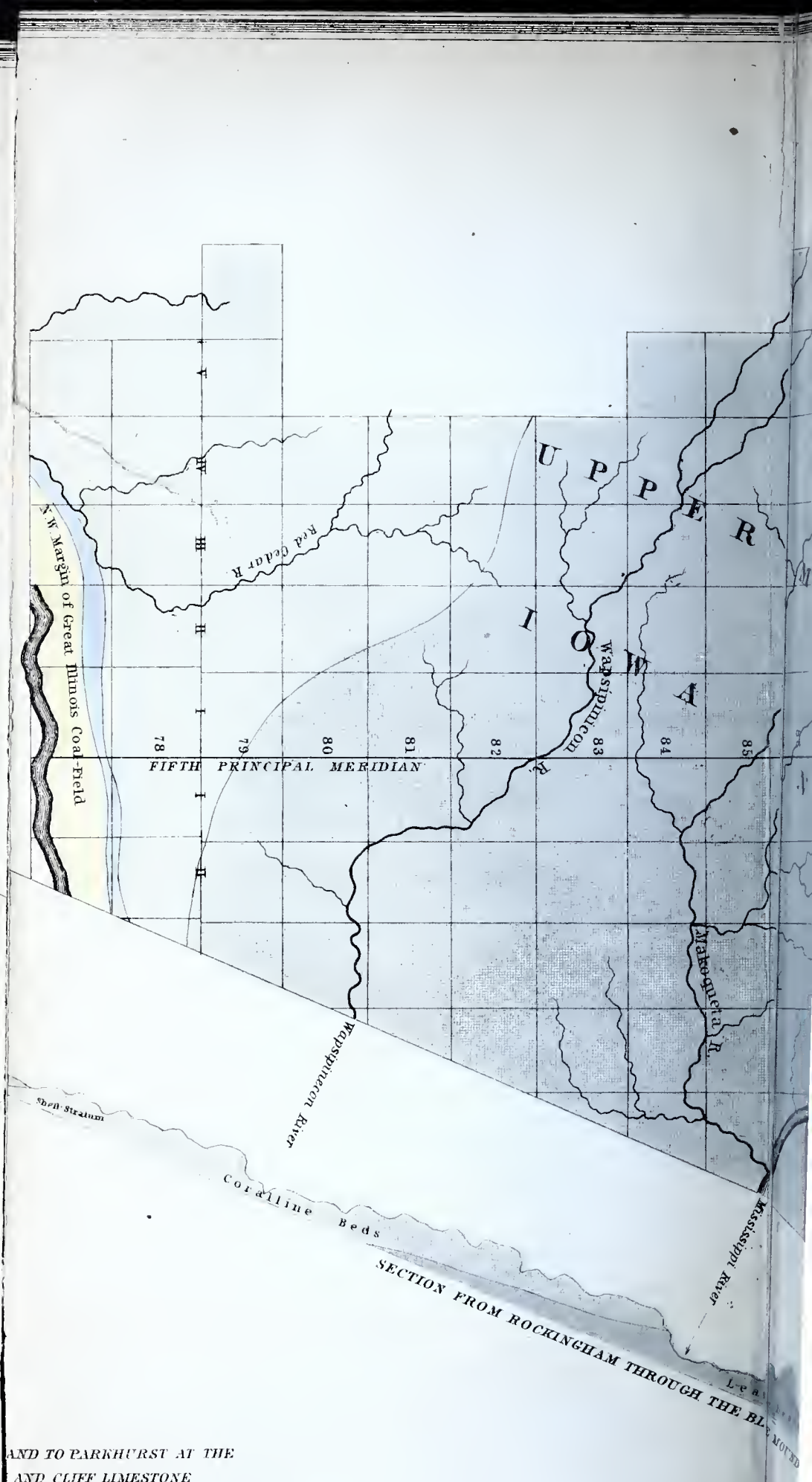
IN THE AUTUMN OF THE YEAR 1839;

WITH CHARTS AND ILLUSTRATIONS.

BY DAVID DALE OWEN, M. D.,
Principal Agent to explore the Mineral Lands of the United States.

ORDERED TO BE PRINTED BY THE SENATE OF THE UNITED STATES,

JUNE 11, 1844.



NATURAL SECTION ON THE MISSISSIPPI FROM THE FOOT OF SMITH'S ISL
MOUTH OF QUARRY CREEK SHOWING THE JUNCTION OF THE COAL MEASURES

AND TO PARKHURST AT THE
AND CLIFF LIMESTONE

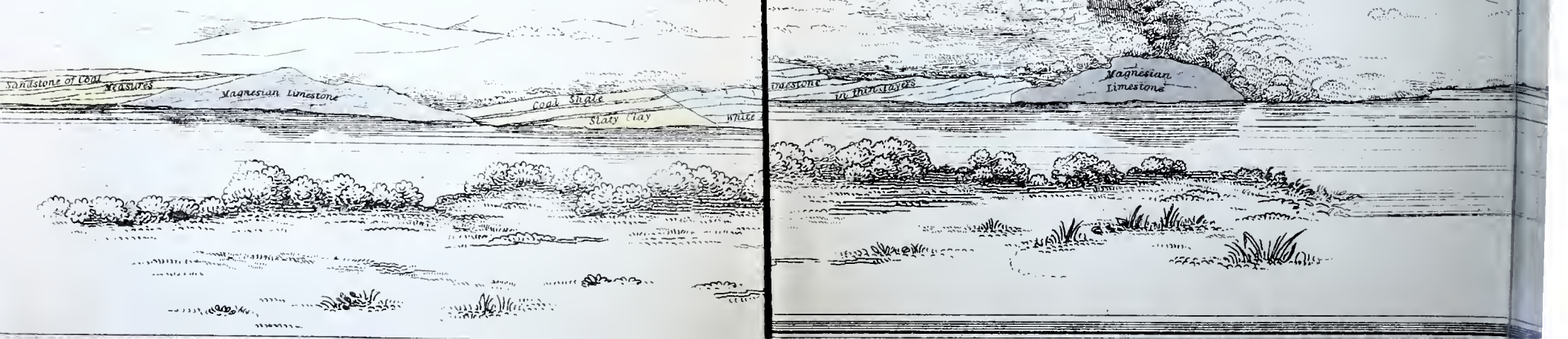


PLATE Nº 3.

GEOLOGICAL SECTION

FROM THE MOUTH OF ROCK RIVER THROUGH THE

BLUE MOUNDS TO THE WISCONSIN RIVER

in connection with a

GEOLOGICAL CHART

OF PART OF

IOWA, WISCONSIN AND ILLINOIS

N.W. of the Section Line

BY D.D. OWEN.

N.W. Margin of Great Illinois Coal field

Sub carboniferous Limestone
Shell Stratum

Coralline beds

Lead bearing beds

Blue fossiliferous Limestone
Buff colored stratum

Lower Magnesian

Limestones and
Red and White Sandstones
of the Wisconsin R.

Cliff rocks of the w

Upper Magn Limestone

WISCONSIN RIVER

Lower Magnesian

Red and White Sand Stone

Buff colored Stratum

Limestone

Fossiliferous

Blue and Grey

ARENA

HELENA

Blue Mounds

Wisconsin River

Limestone

Red and White Sandstone

6

5

4

3

2

1

NE

Mineral Point

Turkey R.

CASSVILLE

Grant R.

Platte R.

L. Platte R.

Pecatonica R.

LIMESTONE

MISSISSIPPI RIVER

FOURTH PRINCIPAL MERIDIAN

WISCONSIN

90

89

88

87

86

DU BUQUE

NORTH BOUNDARY OF ILLINOIS

II WI IE II III

Fever R.

GALENA

MAGNESIAN LIMESTONE OF IOWA

Buffalo Cr.

Pecatonica River

1001 feet above the

BLUE MOUNDS TO THE WISCONSIN RIVER

Blue fossiliferous Limestone

Red and White Sandstone

Lower Magnesian Limestone

Lead bearing Beds

SCALE { Horizontal 12 m. to the inch
Vertical 200 f. " "

is presented in advance of the *plan for the disposal of the mineral lands*, which is now in the course of preparation, and will be laid before you at an early day.

I have the honor to be, very respectfully, your obedient servant,

LEVI WOODBURY,
Secretary of the Treasury.

The PRESIDENT OF THE UNITED STATES.

GENERAL LAND OFFICE, *June* 3, 1840.

SIR: In reply to the resolution of the House of Representatives, passed on the 6th of February, 1839, in the following words: "*Resolved*, That the President of the United States be requested to cause to be prepared, and presented to the next Congress, at an early day, a plan for the disposal of the public mineral lands, having reference as well to the amount of revenue to be derived from them, and their value as public property, as to the equitable claims of individuals upon them; and that he at the same time communicate to Congress all the information in possession of the Treasury Department relative to their location, value, productiveness, and occupancy; and that he cause such *further* information to be collected, and surveys to be made, as may be necessary for these purposes;" and which was referred by you to this office on the 9th of the same month, with instructions to collect the information, and prepare the report, &c.: I have the honor to state, that on examination of the files of this office they were not found to afford any satisfactory information on the subject of the resolution, other than what is imbodied in the report of the Commissioner of the General Land Office, communicated by the President to the House of Representatives on the 28th March, 1824, pursuant to a call of that House, bearing date 8th February, 1823, and which report forms document No. 128 of the 1st session of the 18th Congress, and to which I would beg leave respectfully to refer. But in view of the very extensive regions of country abounding in mineral resources to which the United States have acquired title, and over which the public surveys have been extended subsequent to the date of that report, the information which it affords was deemed insufficient to meet the enlarged requirements of the resolution now referred to; and the application which was immediately made to the Department of War, which has hitherto had special charge of the selection and management of the mineral lands under the existing laws, having resulted only in a reference to former reports on the subject from the Ordnance department, and the Commissioner of Indian Affairs, heretofore communicated to Congress, and printed among the public documents, (none of which were found to afford the desired information,) it was deemed indispensably necessary to appoint a special agent, under the authority given in the last clause of the resolution, to cause further information to be collected and surveys to be made.

In pursuance of your directions, and as early in July last as practicable, after the appointment of Dr. David Dale Owen, (a gentleman of extensive attainments in geological and mineralogical science, and former geologist of the State of Indiana,) the instructions to him for the examination and survey were prepared at this office, in accordance with the general plan of operations which I had the honor to recommend in my communication to

you of the 28th of June last. These instructions were despatched to Dr. Owen on the 8th of August last; and in the anxious desire to afford an opportunity to those whose interests are most deeply concerned in any plans which may be adopted by Congress for the disposal of the lands in question, as also for the purpose of procuring such additional lights as would aid in furthering the objects of the resolution, a circular letter was on the same day addressed to the Governors of Iowa and Wisconsin Territories, and of the State of Illinois, covering a copy of the resolution, and inviting them to communicate plans for disposing of the lands as contemplated by the resolution, to be laid before the President. In addition to which, the registers and receivers of the land offices at Mineral Point, Dubuque, and Galena, and the surveyor general at Dubuque, (in whose districts the public mineral lands containing lead ore are chiefly situated,) were respectively requested to submit plans, accompanied with every information in their power to give, touching *all* the objects of the resolution. Likewise, a letter was addressed to the Hon. Secretary of the Department of War, accompanied by copies of the resolution and of the above instructions to Dr. Owen and the land officers, with a view of obtaining any information on file in that department, and such additional information and plans as might be procured through the medium of its officers and agents whose official duties connected them with the mineral lands. The responses to these calls are proposed to be made the subject of a special report, separate from that of the geologist, which I have now the honor to submit for your consideration.

The report of Dr. Owen, and the documents which accompany it, contain highly valuable information, as sought for by the resolution; and, considering the very short time allowed him for completing the examinations in the field before the setting in of winter, he has exceeded the most sanguine expectations of the department, in the prompt and satisfactory manner in which he has discharged the important duties which were confided to him; and should Congress be pleased to order the publication of the report, with its illustrations and accompanying maps, I feel assured that it will greatly subserve the public interests, by promoting the early sale and settlement of the lands of which it treats, and, at the same time, prove a highly valuable acquisition to the cause of science.

The country examined by Dr. Owen embraces an extent of eleven thousand square miles, which he represents to be, upon the whole, "*one of the richest mineral regions* (compared to its extent) *yet known in the world.*" From the statistics of this report, it appears that all Europe produces 131,700,000 lbs. of lead per annum; of which amount Great Britain alone furnishes about three-fourths. That this part of the lead region of the United States produced, under all present disadvantages in working the mines, arising from the want of sufficient capital and adequate machinery, *thirty millions of pounds* of lead in the year 1839; but is capable of producing annually *one hundred and fifty millions of pounds*, and furnishing employment to ten thousand miners.

Independent of this abundant mineral treasure in lead, there are reported to exist rich supplies of *copper*, *iron*, and *zinc* ores, at present worked to a very limited degree.

Some general idea of the purity of the copper ore of Wisconsin may be derived from the fact mentioned by Dr. Owen, that it yields "from one-

fifteenth to one-third more than the celebrated mines of Cornwall, England."

The value of the lead mines is rendered unequal from sundry causes, and depends upon the dimensions of the vein, its depth and extent, the richness of the ore, the facility of dislodging and raising it to the surface, the comparative cost of conveying the ore from the mine to the furnace, (which, for the convenience of procuring fuel, may be at a greater or less distance from the mine,) and thence to the depot for shipment to market; from the operation of all which causes, it will be readily perceived that it is next to impossible to affix any general *present value* to the lands upon which mines have already been opened, and much less to those that remain to be discovered and fully developed; and many instances which illustrate this fact will be found under the head of "Statistics of the lead region," connected with the report.

It appears that the lead-bearing rock covers nearly the whole surface of the region examined by the geologist, but that the *present discoveries* are confined within narrow limits; and the geological indications seem to warrant the belief in the existence of numerous inexhaustible mines where no actual discovery has yet been made. Hence a very important and, indeed, insuperable difficulty exists in determining what lands shall be treated as mineral lands, under existing laws, unless some mode be prescribed by law for that purpose, which shall be progressive in its operation.

There is no doubt that, throughout the region where the lead-bearing rock abounds, there is a very large proportion of land which is principally valuable for agricultural purposes; and that even within the limits where actual discoveries of lead have been made, and mines worked to a greater or less extent, there are known to be lands wherein the mineral exists in quantities so small as to render them more profitable for agricultural than for mining purposes.

It will be perceived that the explorations which have so far been made, pursuant to the resolution, have been confined particularly to the *surveyed lands* in Illinois, Iowa, and Wisconsin, where lead mineral was supposed to exist, as the time allowed for this purpose did not admit of the examinations being further extended, and particularly as the surveyed lands would be the first operated upon by any plan for the disposal of the lead mines which Congress might see fit to prescribe by law. But it is known, from various official sources, that large districts of country, containing valuable deposites of lead and copper ore, exist in the Northwestern Territory, between the Missouri river and Lake Superior, a part of which it is designed to have surveyed for market, under the general appropriation for surveying for the present year; any provision of law, therefore, for the disposal of mineral lands, differing from that of other public lands generally, would render it necessary to provide, at the same time, a mode by which the tracts containing mineral may be ascertained and discriminated from other lands; and such examination, with little additional expense, might be so extended as to embrace all public lands remaining to be brought into market, at least in those districts where valuable metalliferous deposites are suspected to exist; and the outlay would, it is believed, be abundantly repaid by the early sale and settlement of the lands, although no further advantages were to accrue.

The observations made by the deputy surveyors are necessarily restricted to the mineralogical indications on the immediate lines of the public

surveys, and are consequently of little value as regards the intermediate lands.

The prices paid for surveying are not sufficient to warrant the expectation that, even were the deputy surveyors possessed of the requisite science and practice, their mineralogical observations in the midst of their surveying labors could be made with sufficient minuteness for all useful purposes.

The only efficient means that occur to me, whereby to obtain the information requisite to discriminate mineral lands from those valuable exclusively for purposes of agriculture, is the appointment, by law, of an officer well skilled in the sciences of geology and mineralogy, with authority to employ the necessary assistants from time to time, to explore all the public lands wherein minerals are suspected to exist, which have been surveyed, or are in process of survey, and to make reports that will enable the land officers to identify the same on the township plats of survey, and reserve them from sale accordingly.

It will be seen that Dr. Owen, in his analyses of the soils of the district of country explored, reports as the result, that he "knows of no country in the world, with similar mineral resources, which can lay claim to a soil as fertile and as well adapted to the essential purposes of agriculture."

Believing that it would be a useful accompaniment to the report, I have caused to be prepared connected maps (in sheets marked A to I, inclusive) of the townships explored in Iowa and Wisconsin, on a scale sufficiently large to admit of receiving thereon all the various annotations of mines, diggings, settlements, &c., exhibited by the geologist on numerous detached township plats; and beg leave to submit them in lieu of such detached plats.

To avoid further delay, this report is presented in advance of the plan for the disposal of the public mineral lands called for by the resolution, yet in process of preparation, and which will shortly be laid before you.

I flatter myself that the propriety of this course will be approved, by reason of the essential bearing which the very important information now furnished will be found to have in enabling Congress the more advisedly to pass upon such a plan when submitted.

In conclusion, I would beg leave to invite attention to the various interesting illustrations and maps connected with the report; and, concurring with Dr. Owen in opinion, that the publication of them is indispensably requisite to a correct understanding of the report itself, would therefore respectfully recommend their publication.

All which is respectfully submitted.

JAMES WHITCOMB, *Commissioner.*

Hon. LEVI WOODBURY,
Secretary of the Treasury.

NEW HARMONY, INDIANA, *April* 2, 1840.

SIR: I have the pleasure of transmitting to you, by this post, my report on the mineral lands of Iowa, Wisconsin, and northern Illinois, with the accompanying documents, completed.

In so doing, permit me to invite the attention of the department to some of the principal results imbodied therein.

1. An inspection of the chapters on the "geological character," and on

the "lead mines" of the surveyed district, will show its close resemblance, in *mineral* character, to the celebrated mining district of the north of England, the most productive lead region in the known world, and its similarity in *geological* position to most of the lead regions in continental Europe.

2. The chapter on the "statistics of the lead mines" affords proof that, even under the numerous disadvantages to which this American lead region has hitherto been subjected, it probably produces at this moment nearly as much lead as the whole of Europe, with the exception of Great Britain alone; and that it has indisputable capabilities of producing as much lead as all Europe, Great Britain included.

3. The chapter on "copper ore," and the appended analysis, prove that the copper ore at present mined in Wisconsin is richer and more valuable than the copper ore of Cornwall, the greatest copper district in Europe or the world; exceeding that ore in its yield by from *one-fifteenth* to *one-third;* and that it can be raised with the same expense as lead ore, under the present condition of the mines.

4. That zinc is also abundant, and the zinc ores of excellent quality.

Thus, that the materials for the manufacture of brass exist in profusion over the district.

5. That iron ore, equal in quality to the Tennessee ores, is found throughout the district, in such quantity, that iron works, to any desirable extent, might profitably be established there; and, upon the whole, *that the district surveyed is one of the richest mineral regions, compared to its extent, yet known in the world.*

The chapter on "soils" also shows that, unlike most other mineral regions, it is fertile, and capable of yielding to the farmer a liberal reward for his labor.

I think it probable that in *every* township of the tract marked off on the chart as the productive lead region, valuable and productive lodes of lead will be discovered.

The report is accompanied, as my instructions required, by a detailed list of the principal localities of metallic ores throughout the district.

It is not my province here to remark upon the great and evident importance of these results, or their utility in aiding the President (to employ the words of the resolution which gave rise to the expedition) in "causing to be prepared, and presented to Congress, a plan for the sale of the public mineral lands, having reference to the amount of revenue to be derived from them, and their value as public property." Without an exploration conducted as minutely in detail as that upon which I have reported, no one would have ventured to state, or would have been believed if he had stated, results showing that these lands possess a value not heretofore attributed to them even by the most sanguine.

The further I have proceeded in the task, the more I have felt, not alone its interest to science, but its extreme importance in a pecuniary point of view to a Government which is the owner of public lands amounting to hundreds of millions of acres, and doubtless containing incalculable and inexhaustible mineral resources within their confines.

These considerations would have induced me, under other circumstances, not to hurry through my analysis of ores and ore-bearing rocks and soils, and my report of the various interesting results of the expedition, as I have done, but to bestow upon these the time and consideration which they justly merit. The wording of the resolution, however, requiring that the Presi-

dent should report on the subject "to the next Congress, at an early day," together with the repeated desire expressed by the department that every possible economy consistent with the due performance of the duty assigned to me should be used, have urged me to complete the whole; and I now transmit it to you in a hasty manner, and, I fear, in but an imperfect form.

To effect this, I have employed two of my sub-agents—one in the laboratory, of some practical experience in chemical manipulations; and the other in my office, to copy the charts, diagrams, tables, and report, with its various accompanying documents: the time of both has been constantly occupied; and as without them I must have given my own time in their place, the saving to the department by this arrangement has been the difference between their per diem and my own, besides the advantage of having the report completed some months sooner than I, without their aid, could possibly have completed it. Indeed, the very object of this report, so far as regards the action of the present Congress on the subject, would, under the latter arrangement, have been defeated.

From the wording of the resolution already referred to, I infer that, when the President causes to be submitted to Congress a plan for the sale of the mineral lands, he will also lay before that body the report I now transmit, as a portion of the "further information" he was requested to collect and to communicate to Congress.

If so, and if the House (as I trust they will) should order the report to be printed, the effect incidentally produced by its circulation will, I cannot help believing, be very advantageous as regards the settlement of the public lands in the northwest by an enterprising and useful class of settlers. Should it be noticed (as, from its official character, it is not unreasonable to presume it may) by the scientific writers of Europe, it may be the means of attracting capital and enterprise from across the Atlantic. This would result not only in advantage to the country, but in direct pecuniary gain to Government, under any plan which may be adopted for the sale of the mineral lands.

If the report be printed, it is indispensable to a correct understanding of the same that the illustrations should be printed along with it.

I respectfully invite your attention to that chapter in my report which refers to the report of Dr. Locke. You will perceive, from looking over that chapter, that so much of Dr. Locke's report as relates to objects of mere curious research, and the examination of which was not included in my instructions, is offered gratuitously, and without any cost to Government.

It has been my constant endeavor, throughout the conduct of this expedition, to observe the strictest economy that was consistent with a faithful attainment of the great objects which I was instructed to accomplish. And I trust that, when the extent of territory to be explored, and the necessarily minute character of the exploration, are borne in mind, it will be admitted that my endeavors have not been unsuccessful. The *per diem* fixed by the department was, I believe, the lowest at which steady and efficient sub-agents and assistants could have been engaged. And, in order to aid in making the men satisfied with their wages, after organizing for them a system of purveyance, I charged them the bare cost of the supplies, without even a per centage for the risk I myself incurred, and the loss to which, by that risk, I was exposed.

In regard to the specimens collected, they were in a great measure in-

dispensable, to enable me to make not only my general but my special reports with fidelity and exactness. I have, in accordance with your recently eceived instructions, meanwhile retained them here; and shall strictly attend to any future instructions which may be forwarded to me regarding their final disposition.*

The vouchers for the small amount still outstanding to complete the cost of the expedition shall be forwarded to you by next post, together with an abstract of the entire accounts of the expedition, from its commencement to its termination.

As this letter contains a brief synopsis of the results exhibited in my report, I suggest the utility, if that report is laid before the President, of accompanying it with a copy of this communication.

The report is enclosed in a tin box, and the accompanying charts, &c., in a tin case; and both are mailed to your address on the same day as this letter.

I am, sir, your obedient servant,

DAVID DALE OWEN,

Principal Agent to explore the Mineral Lands of the United States.

Hon. JAMES WHITCOMB,

Commissioner of the General Land Office.

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* The specimens here referred to have been since sent to Washington.

REPORT

BY

DAVID DALE OWEN, M. D.

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INTRODUCTION.

No. I.

NEW HARMONY, INDIANA, *January* 20, 1840.

SIR: Your communication of the 31st of July last, covering my commission as principal agent to explore the mineral lands of the United States, and containing instructions what lands to survey, and how to conduct the examinations, reached me at this place on the 17th of August.

These instructions, prepared by direction of the Secretary of the Treasury, under a resolution of the House of Representatives of the 6th of February last, required me to proceed to Iowa, and undertake an exploration of "all the lands in the Mineral Point and the Galena districts, which are situated south of the Wisconsin and north of the Rock river, and west of the line dividing ranges eight and nine east of the fourth principal meridian; together with all the surveyed lands in the Dubuque district;" comprehending, in all, upwards of three hundred townships of land. This exploration I was required to complete "before the approaching winter should set in."

In regard to the nature of the exploration to be made throughout this district of territory, I was informed that "it had been decided by the Secretary of the Treasury that the investigation should embrace every description of mineral deposite, calculated to impart so much value to the land as would justify the expense;" and I was instructed to "note carefully the result of the examinations of the mineral appearances of each tract of land, its situation in the section, how occupied, and such facts as will serve to convey some idea of its value and productiveness."

I was further informed, that it was "the anxious desire of the Secretary that all the lands in the Dubuque district found *not* to contain appearances of lead mineral or salines, and not otherwise reserved by law, should be brought into market next (now last) fall, at the earliest day practicable;" and I was accordingly instructed to "report to the General Land Office, and to the register, lists of all such lands, from time to time, as fast as I should have completed the examinations of (say) from ten to fifteen townships sufficiently to enable me to certify the fact that they do not contain appearances of lead mineral or salines, in order that the same may be proclaimed for sale, successively, as the lists shall be received;" which special reports, however, I was informed, were to "form no part of my general report," which I was instructed to make after completing the examinations of the entire district to be explored, and which report I was required to accompany with a "general list of all the lands found to contain appearances of mineral or salines, as far as situated in the surveyed lands, with appropriate remarks opposite to each tract, to be likewise accompanied by connected diagrams showing the precise locations."

I was also instructed to "select specimens of all the minerals of much

value, accompanying each with the designation of the quarter section, township, and range, from whence the same shall have been taken," and to forward these to Washington city; as such a collection was deemed important to illustrate my official report, and enable the department to judge better of the value of the lands, and also interesting as forming a nucleus for a national cabinet.

In regard to the force which I was permitted to employ, I was informed that, "with a view of completing the examinations before the approaching winter," the Secretary had assented to my "employing as many sub-agents and assistants as I might deem requisite for the purpose."

After duly weighing the nature of my instructions, estimating the extent of country to be examined, considering the wild unsettled character of a portion of it, and the scanty accommodations it could afford to a numerous party, (which rendered necessary a carefully calculated system of purveyance,) and ascertaining that the winter, in that northern region, commonly sets in with severity from the 10th to the middle of November, my first impression was, that the duty required of me was impracticable of completion within the given time, even with the liberal permission in regard to force accorded to me in my instructions. But, on a more careful review of the means thus placed at my disposal, I finally arrived at the conclusion, that, by using diligent exertion, assuming much responsibility, and incurring an expense which I was aware the department might possibly not have anticipated, I might, in strict accordance with my instructions, if favored by the weather and in other respects, succeed in completing the exploration in the required time.

I therefore immediately commenced engaging sub-agents and assistants, and proceeded to St. Louis; there (at my own expense, to be repaid to me out of the *per diem* of the men employed) I laid in about three thousand dollars worth of provisions and camp furniture, including tents, which I caused to be made for the accommodation of the whole expedition; and in one month from the day on which I received my commission and instructions in Indiana, (to wit, on the 17th of September,) I had reached the mouth of Rock river; engaged one hundred and thirty-nine sub-agents and assistants; instructed my sub-agents in such elementary principles of geology as were necessary to the performance of the duties required of them; supplied them with simple mineralogical tests, with the application of which they were made acquainted; organized twenty-four working corps, furnished each with skeleton maps of the townships assigned to them for examination, and placed the whole at the points where their labors commenced, all along the southern line of the western half of the territory to be examined. Thence the expedition proceeded northward, each corps being required, on the average, to overrun and examine thirty quarter sections daily, and to report to myself on fixed days at regularly appointed stations: to receive which reports, and to examine the country in person, I crossed the district under examination, in an oblique direction, eleven times in the course of the survey. Where appearances of particular interest presented themselves, I either diverged from my route, in order to bestow upon these a more minute and thorough examination; or, when time did not permit this, I instructed Dr. John Locke, of Cincinnati, (formerly of the geological corps of Ohio, and at present professor of chemistry in the medical college of Ohio,) whose valuable services I had been fortunate enough to engage on this expedition, to inspect these in my stead.

By the 24th of October, the exploration of the Dubuque district was completed, and the special reports of all the townships therein were despatched to your office and to the office of the register at Dubuque. On the 14th of November, the survey of the Mineral Point district was in a similar manner brought to a close; and by the 24th of November our labors finally terminated at Stephenson, in Illinois; the examinations of all the lands comprehended in my instructions having been completed in two months and six days from the date of our actual commencement in the field. Also, several thousand specimens, some of rare beauty and interest, were collected, arranged, and labelled.

The weather was favorable, and the winter did not set in with severity until about a fortnight later than is usual in that latitude; yet, the same day on which the survey was completed, a severe snow storm occurred, a gale blew up from the northwest, the thermometer fell to 12 or 14 degrees below zero, and the expedition could not have continued its operations in the field a single day longer.

The details of this exploration, exhibiting results of an interest and importance far beyond my anticipations, and equally, perhaps, beyond those which the department may have formed, are submitted in the following general report.

GENERAL REPORT.

SITUATION AND EXTENT OF THE COUNTRY EXPLORED.

The district of territory which has been explored lies nearly in equal portions on both sides of the Mississippi river, between latitude 41 and 43 degrees, commencing at the mouth of Rock river, and extending thence north, upwards of 100 miles, to the Wisconsin river, which discharges itself into the Mississippi immediately below Prairie du Chien.

The average width of this body of land exceeds 100 miles. It comprehends about 11,000 square miles, equalling in extent the State of Maryland.

ITS GEOLOGICAL CHARACTER.

To a correct understanding of the geological formations of this district, without which its probable value as a mineral region cannot be correctly appreciated, a few words of general explanation may be required.

A casual observer may imagine that the various rocks which compose the crust of our globe are thrown together in indiscriminate confusion; but those who have given even a superficial attention to the science of geology know that the order of superposition among these rocks is constant. The various geological strata overlie each other in a succession which is invariable, with the exception of trifling alternations sometimes occurring at the junction of two formations.

Beneath, at the greatest depths, are found granite and other *crystalline* rocks of a similar character.

Lying above these, are the *primary fossiliferous strata*, such as occur throughout America beneath the coal formation.

Above these lie *secondary strata*, including the mountain limestone, the coal measures, the salt-producing rocks of England, the oölite, and the chalk.

Above these secondary rocks occur the *tertiary strata*, a succession of marine and fresh-water deposites, such as are found in the United States, along the Atlantic seaboard, and on the Mississippi river as high as Vicksburg.

Last, and resting upon these, are found the *recent deposites*, such as constitute river bottoms, and occur throughout the richest lands in the Western States.

This order of succession is never inverted, though occasionally certain classes of rocks are in whole, or more frequently in part, deficient. Thus the *recent deposites* exist (if they exist at all) universally above all the other classes of rocks; the *tertiary* above all except the *recent deposites;* and so of the rest.

This invariable order of succession supplies the geologist's most trustworthy guide in his researches after mineral riches; for certain minerals are found almost exclusively in certain formations. The geologist is thus

enabled to predict, previously, in any examination in detail, where gold, where iron, where lead, and where other valuable mineral products are likely to occur, and where it would be in vain to look for these.

The several layers and classes of stratified rocks above enumerated are believed to have been originally deposited nearly in a horizontal position, thus. (*See plate No.* 1, *fig.* 1, *after page* 68.)

If they had so remained, we could have known but little of any except the superior strata. But it will readily be perceived, that some great convulsion of nature, heaving up the lower rocks, and causing them to burst through and displace the upper and superincumbent layers, might produce an arrangement similar to this. (*See plate No.* 1, *fig.* 2, *after page* 68.)

Thus the crystalline and other hypogene* rocks might become the most elevated, and be found occupying the summits of the lofty and rugged mountain ranges; while the others would slant up in succession to the surface, flanking the mountain sides, and extending over the inferior ridges and plains; the superior strata being commonly found the most remote from the primitive and crystalline rocks.

This, in effect, seems to have occurred, with various modifications, throughout the known world. We find each group of rocks appearing in succession on the surface of the earth, dipping at various angles, and sinking beneath the surface as each approaches the next overlying stratum, which, in its turn, disappears beneath a superior series. And as we ascend the highest mountains we frequently find those strata, which, by a horizontal arrangement, would be the deepest seated, heaved up into the loftiest positions. Such are the granite peaks of the Alps and Alleganies, and the masses of porphyry which occur at the highest altitudes among the Andes.

But for some such arrangement as this, many of our valuable mineral deposites would be inaccessible, for most of the metallic ores are confined to inferior strata. As it is, all the formations are presented to the geologist in different portions of our globe; and thus, as each class of rocks has its peculiar ores and minerals, these are distributed near the earth's surface, where metalliferous and mineral-bearing strata have their outcrop. Thus, too, important practical results are obtained, by a careful examination of the extent and localitities of the various formations, and, as a consequent, by the study of the imbedded fossils, the presence of which constitutes the most decisive evidence of the identity of geological strata.

Throughout the Western States, generally, the *primary fossiliferous* (*protozoic*) and *lower secondary* (*carboniferous*) rocks prevail, covered up in various locations, sometimes to a considerable depth, by recent alluvial and diluvial deposites.

These two formations comprehend (as do all the others which have been enumerated) various subdivisions of distinct character and invariable succession, which in their turn have been again subdivided.

As some of these subdivisions prevail in the district of country upon which it is my present duty to report, it is important to take note of them. Accordingly, they are here represented. (*See plate No.* 1, *fig.* 3, *after page* 68.)

These are the chief groups composing the primary and secondary strata,

* Originating from beneath.

Fig 1.

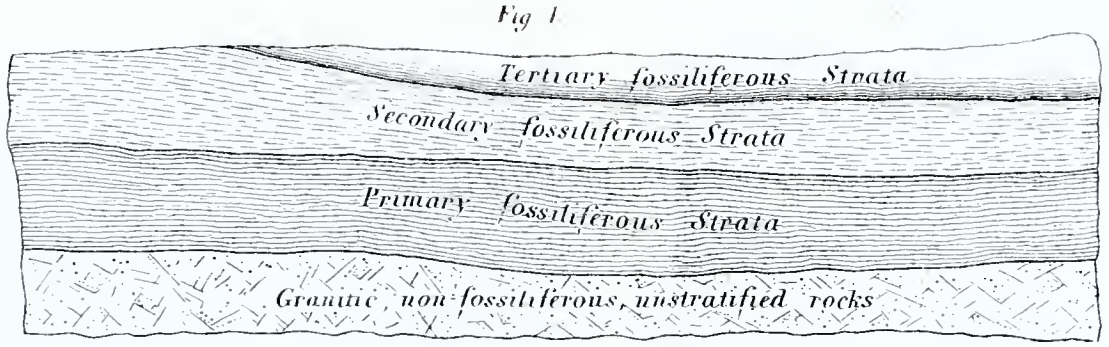


Fig 2.

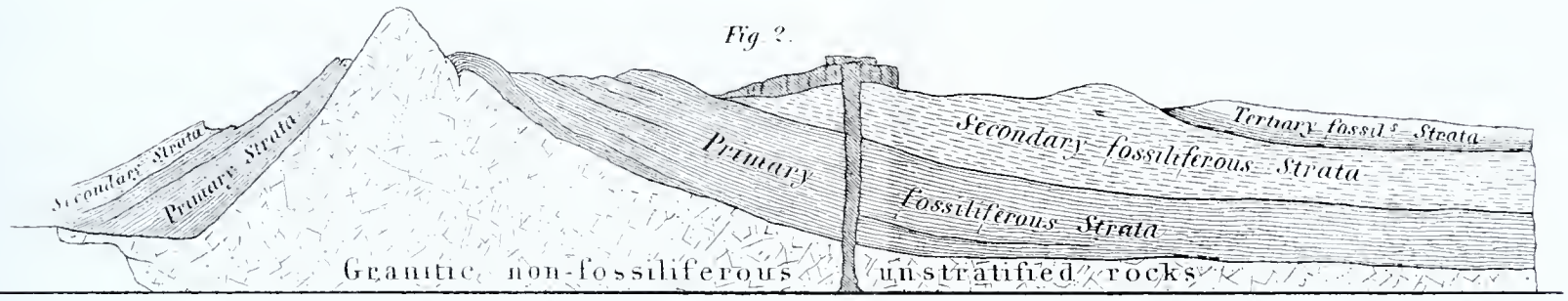


Fig. 3.

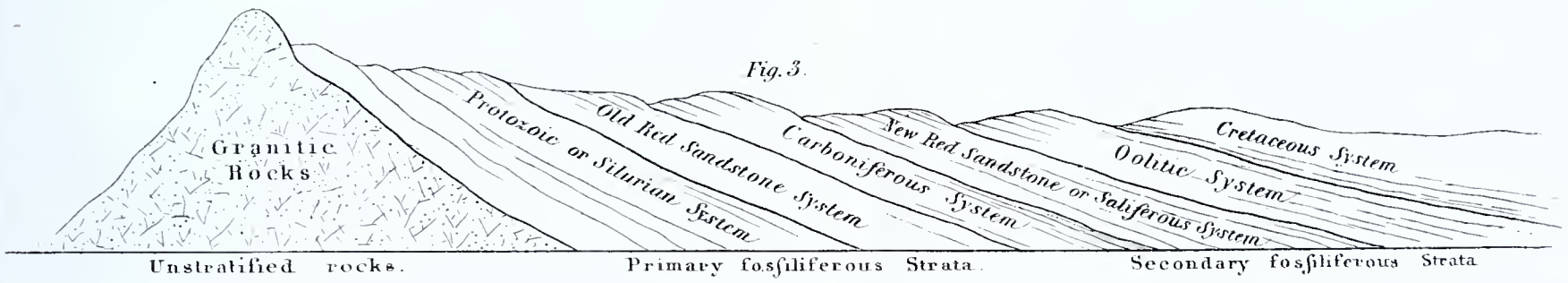


Fig. 4.

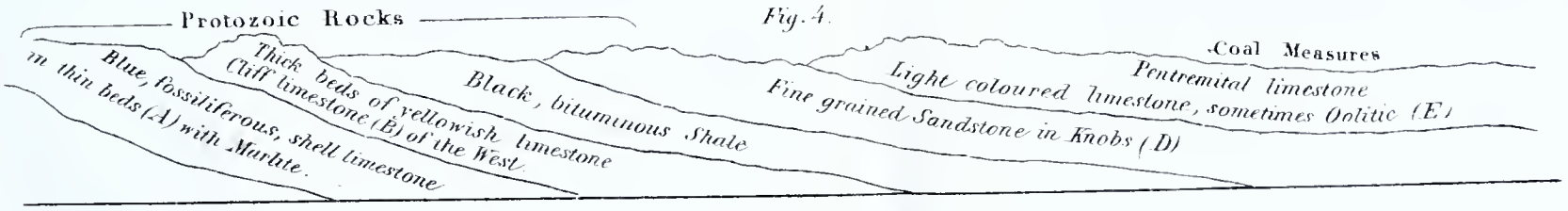


Fig 5.

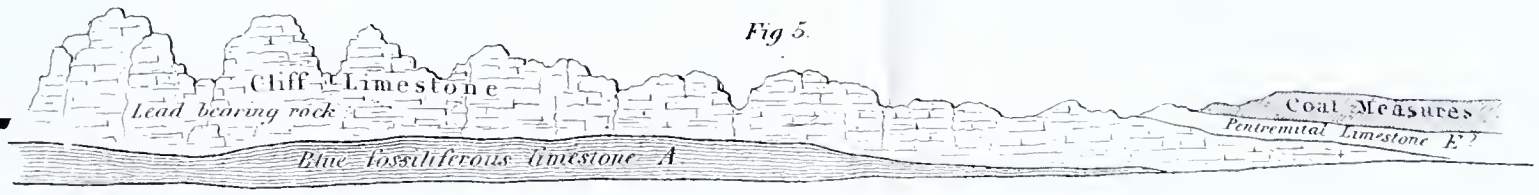


Fig 6.

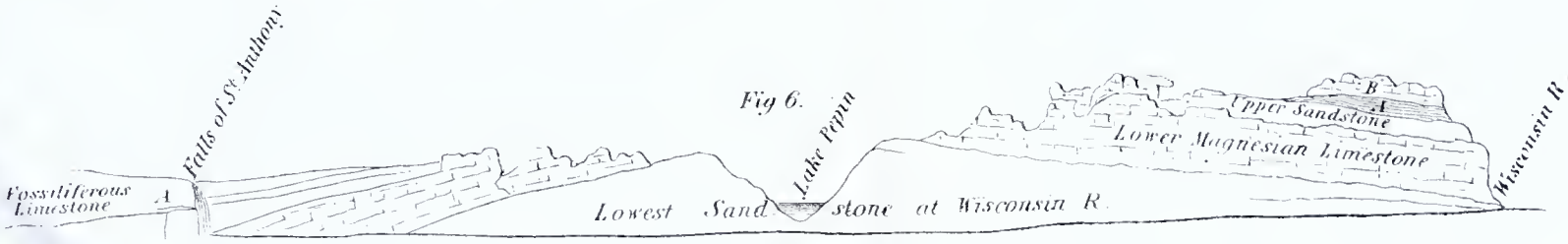
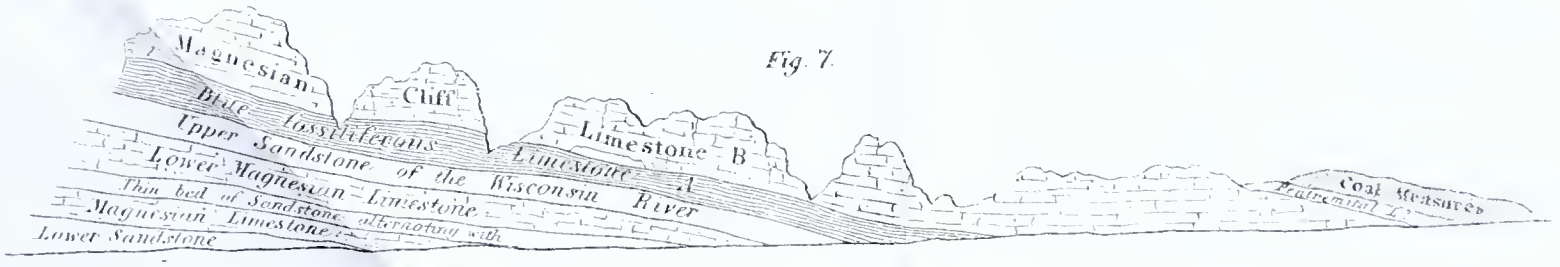


Fig. 7.



These are the chief groups composing the primary and secondary strata,

* Originating from beneath.

represented in the order in which they succeed to and rest upon each other, in the old world.

Amongst these, the protozoic or silurian system especially claim our attention, as almost all the rocks of Iowa and Wisconsin are referable to that system. In the States of Ohio, Indiana, Kentucky, and Tennessee, where the principal members of this system are more complete and distinctly marked, the subdivisions observable are these. (*See plate No.* 1, *fig.* 4, *after page* 68.)

These rocks attain, however, a much greater thickness in the State of New York. Indeed, there is probably no other country yet explored, where these protozoic strata are found in so complete undisturbed development. The New York geologists have, for this reason, distinguished them under the name of the *New York system*. For the sake of being able to refer the rocks of the district explored as well to their New York as to their English equivalents, I insert on the next page a table, a modification of one which appeared in Mr. Hall's report of the 4th geological district in New York, giving a comparative view of the correspondence between the various members of the New York and English protozoic strata.

Tabular arrangement of American and English protozoic rock.

No.	New York survey.	Pennsylvania survey.	Ohio and Indiana survey.	Michigan survey.	English survey.
1	Potsdam sandstone	No. 1	- - - - -	- - - - -	Lowest silurian or cambrian rocks: not so fully recognised in Great Britain as in New York.
2	Calciferous sand rock	No. 2			
3	Black river and Birdseye limestone.	No. 2			
4	Trenton limestone	No. 2	Blue limestone and marl formation		Llandeilo flags.
5	Utica slate	No. 3		- - - -	
6	Hudson river group	No. 3			
7	Oneida conglomerate	No. 4	- - - -	- - - -	Caradoc sandstone.
8	Gray sandstone	No. 4	- - - - -	- - - - -	
9	Medina sandstone	No. 5	- - - - -	- - - - -	
10	Clinton group	No. 5	Lower part of cliff; "flinty stratum" of Adams county, Ohio; oölitic iron ore of Clinton county, Ohio	- - - - -	
11	Niagara group	Part of No. 6	Part of cliff limestone	- - - - -	
12	Onondaga salt group	- - -	But partially developed in S. W., but more extensively in N. part of Ohio.	Mackinac limestone; gray, sandy, and porous limestone - - -	Wenlock rocks.
13	Water limestone	Included in No. 6, if existing.			
14	Pentamerus limestone		Not recognised		
15	Delthyris shaly limestone			In this series are included the Little Traverse bay limestone; black bituminous limestone; blue limestone, in thick regular layers; Thunder bay limestone?	
16	Enerinal limestone				
17	Upper pentamerus limestone				
18	Oriskany sandstone	No. 7	Sandstones of Fall creek, Indiana?		
19	Cauda galli grit	No. 7	- - - - -		
20	Schoharie grit	- - -	- - - - -		
21	Onondaga limestone	- - -	Coralline and shell beds of cliff limestone.	Corniferous	
22	Corniferous limestone	- - -			
23	Marcellus shale	No. 8	Black slate	Shales; black aluminous shale	Lower and upper Ludlow rocks, including Devonian system of Phillips.
24	Hamilton group	No. 8			
25	Tully limestone	- - -	- - - - -	- - - - -	
26	Genesee slate	No. 8	- - - - -	- - - - -	
27	Portage group	No. 9	Waverly sand; fine-grained sandstone of the knobs.	Soft, light-colored sandstone; argillaceous slates of Lake Huron; sandstones of Point aux Barques	
28	Chemung group	No. 9			

In the Western States, above mentioned, these subdivisions generally vary in thickness from one hundred to one thousand feet, with the exception of (B) cliff limestone of the West,* which in some districts (Tennessee) is hardly distinguishable, and in general does not exceed eighty or one hundred feet in thickness.

Now, this cliff limestone, so sparingly developed in the Southwest, swells, in the Wisconsin and Iowa lead region, into the most remarkable, most important, and most bulky member of the group. It becomes, as it were, the Aaron's rod, swallowing up all the rest. It attains a thickness of upward of five hundred and fifty feet, while the underlying blue limestone (which in Ohio has usually from eight hundred to one thousand feet of thickness) shrinks in many places to less than one hundred feet, and in others seems almost wanting; while, at the same time, the black slate, (C,) commonly found above the cliff limestone, seems also deficient; and it is doubtful whether the fine-grained sandstone (D) or the pentremital limestone (E) can be detected at all in the tract of country which has been subjected to exploration.

In a word, in the region now under consideration, the cliff limestone, (B,) with a variable and usually thin substratum of blue limestone, (A,) seems to engross almost the entire protozoic system; and the coal measures, where found, (namely, in the extreme southern boundary of the tract,) occur nearly in immediate contact with (B,) instead of being separated, as usual in Ohio and the neighboring States, by three distinct members, occupying about one thousand feet in thickness.†

In Wisconsin and Iowa, then, instead of the various subdivisions, as given in the last diagram, the geologist finds but these. (*Vide plate* 1, *figure* 5, *after page* 68.)

This enormous development of one of the members of the protozoic system, and the almost complete obliteration of the rest, (with the single exception of the blue limestone, (A,) upon which also it much encroaches,) is peculiar, so far as my observations in the Western States extend, to the district of country which is the object of the present report. To the north of this district, the cliff limestone (B) appears to run out, and the blue limestone (A) rises nearly to the tops of the hills. South, it disappears beneath the coal measures. East, it seems to be chiefly covered up by recent deposites, extending probably in an east or southeasterly direction beneath these, across the northern part of the States of Illinois and Indiana, into the State of Ohio. And west, so far as our examinations went, it is also chiefly covered up by recent deposites—occurring, however, occasionally in the beds of the streams, and projecting at first in cliffs, and at last only in low ledges from their banks.

The general geological character of the country explored may then be thus briefly summed up: All the rocks belong to the *palæozoic* period, or to that grand division of the stratified rocks called by some modern geologists *primary fossiliferous*, and formerly known as the transition series. And, if we except a few strata in the southern portion of the district, appertaining to the carboniferous era, they belong, further, to a division of

* The origin of this term, and my reasons for adopting it, are given at length in another part of the report.

† In some parts of the southern portion of the Dubuque district, there occur a few feet of limestone, which may probably be referred to the pentremital limestone. It is seen near Rockingham and Stevenson.

these rocks described in England as the *protozoic* or *silurian system*, better known in the United States as the *New York system;* and, saving some of the substrata occupying a narrow area in the north, they belong, yet more especially, to a subdivision of this system called in Great Britain the *Wenlock formation;* in New York, the *Niagara, Onondaga*, and *corniferous limestones;* and known popularly, where it occurs in the West, as the "*cliff limestone,*" being described under that name by the geologists of Ohio.

This last is the rock formation in which the lead, copper, iron, and zinc of the region under consideration are almost exclusively found; and its unusual development doubtless much conduces to the extraordinary mineral riches of this favored region. It therefore demands, and shall hereafter receive, particular analysis and attention.

In the northern portion of the district surveyed, an interesting and somewhat uncommon feature in the geology of western America presents itself. I refer to the strata (of considerable thickness) which crop out along a narrow strip of the northern boundary line of this district, and which are chiefly observable in the bluffs on both sides of the Wisconsin river.

These strata are interesting, first, as being the only instance known to me west of the Cumberland mountains, east of the Mississippi, and south of this lead region, in which the rocks underlying the blue limestone (A) can be seen emerging from beneath it to the surface; and, secondly, as supplying an example of alternations of neighboring strata, to which I have already alluded.

Immediately beneath the substratum of blue limestone (A) there occurs, and shows itself on the Wisconsin bluffs, a stratum of sandstone in some places variegated or of a deep red, in others of a white color,* and composed of pure and slightly coherent grains of limpid quartz, called, in Dr. Locke's diagrams exhibiting the sections on the Wisconsin river, *saccharoid* (or sugar-like) sandstone.

Immediately beneath this, succeeds a magnesian limestone, so similar to the cliff limestone, (B,) both in external appearance and chemical composition, as not to be distinguishable from it in hand specimens,† alternating with other layers of sandstone similar to that above described.

So that the limestones of this district, exhibited in connexion with these underlying strata, appear thus. (*Vide plate* 1, *fig.* 6, *after page* 68.)

The above example of the blendings of adjacent strata constitutes, doubtless, an alternation of lower members of the same system; probably the western equivalents of the Potsdam sandstone, calciferous sandrock, and Black river limestone of the New York reports.

These underlying beds continue to rise higher in the hills in a northwest direction, up the Mississippi, until near Lake Pepin, where there appears to be an anticlinal axis; beyond this they again decline, so that the falls of St. Anthony are constituted of the fossiliferous limestone (A) and underlying sandstone alone, the lower magnesian limestones and sandstones

* This variety, when free from carbonate of lime, will make an admirable material suitable for the manufacture of glass.

† It differs, however, from the cliff rock in several particulars, when examined in *situ*. It is almost destitute of fossils; its lower members have sometimes a greenish tint; the imbedded siliceous masses are either crystallized or more rugged and quartzose than those of the cliff rock. Beautiful crystallized specimens of ferruginous quartz are of frequent occurrence in its beds; and chert of an oölitic structure (made up of minute egg-shaped grains, like the roé of a fish) is also abundant.

GEOLOGICAL CHART
OF PART OF
IOWA, WISCONSIN, AND ILLINOIS.
BY D. D. OWEN

Lith. by E. Weber & Co. Baltimore

having disappeared there beneath the waters of the Mississppi, as in the section beneath. (*Vide plate* 1, *fig.* 7, *after page* 68.)

The lower magnesian limestone and associate sandstones closely resemble, in structure, position, and deficiency of fossils, the rocks prevailing throughout the lead region of Missouri, and are probably their equivalents. If so, we are furnished with a clew to the true geological position of that region—a point heretofore undecided.

If, in connexion with this brief outline, the colored charts numbered 2 and 3 be inspected, it will be easy to form a general idea of the relative position, extent, range, bearings, succession, dip, and thickness of the geologieal strata which occur in the district I was instructed to explore.

Chart No. 2 (*vide plate No.* 2, *after page* 68) exhibits the superficial extent, succession, and bearings of these strata, as they come fairly to the surfaee. The brown color along a strip in the extreme south designates the bituminous coal measures, as they abut against the upper beds of the cliff limestone. This is the extreme northwestern margin of an immense coal basin, which occupies the greater part of Illinois, about one-third of Indiana, a northwestern strip of Kentucky, and, occasionally encroaching beyond the Mississippi, extends a short distance into the State of Missouri, and into the Burlington district of Iowa. Chart No. 4 (*vide plate No.* 4, *after page* 68) exhibits with general accuracy the form and extent of this gigantic coal field, the superficial area of which equals that of the entire island of Great Britain.

In chart No. 1, the lighter purple tints, occupying nearly *six-sevenths* of the whole district, represent the cliff limestone, covering a surface of upwards of nine thousand square miles. Within this boundary, all the productive lodes of lead ore yet discovered are to be found, as in another part of this report will be more particularly shown. The blue color (indigo) designates the blue fossiliferous limestone, forming a belt, which runs with undulations east and west, broadest near the mouth of the Wisconsin river, and very narrow in the vicinity of the Blue Mounds.

The buff stripe, north of the last-described rock, represents a narrow belt of buff-colored limestone, of little importance; it was not detected west of the Mississippi.

The red color and darkest purple desiguate, the first the red and white sandstone, and the second the lower magnesian limestone of the Wisconsin river, which alternate with each other.

Chart No. 3 (*vide plate No.* 3, *after page* 68) contains a vertical section, running obliquely through the district, nearly in a line with the greatest dip, commencing at Rockingham, immediately below the mouth of Rock river, and running thence through the Blue Mounds to the Wisconsin river, at the northeast corner of the tract; exhibiting the order, dip, and thickness of the strata, as they successively sink from the surface, and gradually disappear beneath the beds of the streams. A horizontal geological chart, similar to a part of chart 2, but cut off so as to correspond with the above vertical section, is added, and further illustrates the manner in which the successive strata come to the surface, and extend over a larger or smaller portion of country in proportion to their dip and thickness.

The vignette on this chart is a view on the Mississippi river, about five miles above the mouth of Rock river, exhibiting the interesting geo-

logical spectacle of the coal measures abutting immediately on the cliff limestone.

The coloring on this chart corresponds with that on chart No. 2.

In this chart, the dip and heights, compared to the horizontal distances, are necessarily exaggerated, The actual average dip of the rocks throughout the district, according to the observations made by Dr. Locke, is from *nine* to *ten* feet per mile, but it is occasionally much greater; for example, from the mouth of Turkey river to Prairie du Chien, the blue limestone rises at an average rate of *seventeen and a half* feet per mile. The dip, however, is subject to undulations; for instance, at Dubuque, the blue limestone does not show itself above low-water mark; at Eagle point, a mile and a half up the Mississippi, it rises ten feet above low water; at the mouth of the Little Mekoqueta, four miles farther up, its height above low-water mark is forty feet; at the mouth of Turkey river, twenty miles farther up, it disappears again beneath the waters of the Mississippi; a few miles beyond this point, it emerges again to the surface; and, finally, at Prairie du Chien, twenty miles above Turkey river, its upper surface has already attained an elevation of more than four hundred feet above the level of the Mississippi. The line of greatest general dip is about south, ten to twenty degrees west.*

The importance of these observations on the dip of the rocks, forming as they do the materials to calculate the thickness of each stratum at any given spot, is very great. Indeed, such observations are indispensable, before an accurate estimate can be formed of the value and extent of a mineral tract. They indicate, with much fidelity, the depth to which, at different points, a productive vein of ore is likely to extend.

The diagrams attached to Dr. Locke's report, which exhibit vertical sections of the strata (specifying the thickness of each) at Dubuque, Prairie du Chien, and the Blue Mounds, and also his diagram of relative heights, supply much useful and accurate information on the subject.†

I now proceed to describe more accurately the prevailing and lead-bearing rock of the explored district, namely:

THE CLIFF LIMESTONE.

I have adopted the name of *cliff* limestone to designate this rock, (though a popular rather than a scientific term,) because it aptly expresses its most striking external characteristic, which imparts to the scenery of any country in which the rock abounds a bold and romantic character. I allude to

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* There are, however, several local tilts in the southern portion of the district. Sometimes the dip there is to the northeast and north, and even occasionally to the northwest, as if some dislocation of the cliff formation at its junction with the coal measures had occurred, and its southern margin had been slightly elevated towards the southwest and south by a lesser force than that which raised the whole mass to the northeast. On Crow creek, northeast of Davenport, the northern dip can be distinctly seen.

Indeed, there are appearances of a slight disposition in the whole strata to dip towards the centre of the lead region, (the vicinity of the Platte Mounds;) for the underlying blue limestone, which appears on the surface where the cliff limestone runs out, may be traced in a narrow, somewhat semicircular band, circumscribing the lead region from Turkey river nearly to the point where the Peccatonnica enters the State of Illinois; in the southern portion of that line, however, only visible in the cuts of the streams.

† I regret that the severe indisposition of Dr. Locke at Mineral Point and Galena prevented the completion of several observations in connexion with this important subject.

its disposition to cleave vertically, and form perpendicular cliffs,* as here represented. (*See plate No. 5, after page* 68.)

These mural escarpments, exhibiting every variety of form, give to the otherwise monotonous character of the landscape in Iowa a varied and picturesque appearance. Sometimes they may be seen in the distance, rising from out the rolling hills of the prairie like ruined castles, moss-grown under the hand of time. (*See plate No.* 6, *after page* 68.)

Sometimes they present, even when more closely inspected, a curious resemblance to turrets, and bastions, and battlements, and even to the loop-holes and embrasures of a regular fortification. Sometimes single blocks are seen jutting forth, not unlike dormant windows rising through the turf-clad roof of an old cottage; and again, at times, especially along the descending spurs of the hills, isolated masses emerge in a thousand fanciful shapes, in which the imagination readily recognises the appearance of giants, sphinxes, lions, and innumerable fantastic resemblances.

The appearance of this rock is further modified by the peculiar manner in which it weathers. Numerous masses of chert, (a variety of flint,) and also many siliceous fossils, are interspersed through its mass; and these, becoming gradually loosened by the action of air and water, drop out, and leave cavities of various shapes and sizes. Thus the rock is frequently found riddled with irregular holes, from a few inches to a foot in diameter, giving its surface a rugged and almost bone-like appearance, similar to the specimen here represented. (*See plate No.* 7, *figure No.* 1, *after page* 68.) Frequently this variety in the composition of the rock gives occasion to an undermining process on the lower surface of a cliff, which gradually proceeds until, perhaps, a towering and tottering column remains, supported on a contracted base, which threatens every moment to give way, and precipitate the poised mass into the valley beneath. The annexed sketch (*see plate No.* 8) represents one of these weather-worn cliffs on the Mississippi, about two miles below Dubuque—an object which seldom fails to attract the attention of the traveller ascending, for the first time, the upper Mississippi.

The cliff limestone of Iowa is, strictly speaking, a magnesian limestone, containing (by careful analyses† of four separate specimens from different localities) from *thirty-five* to *forty* per cent. of carbonate of magnesia.

It contains, on the average, from eighteen to twenty per cent. of pure magnesia; and, by mere solution in sulphuric acid, is capable of yielding no less than one hundred and ten to one hundred and twenty parts of crys-

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* It is true, that limestones immediately beneath the coal measures—pentremital limestones—higher in the series than the cliff limestones, are seen along the Mississippi, above and below St. Louis, in abrupt ledges; but they are not often in as thick uniform beds as the cliff limestone, and therefore seldom appear in mural escarpments, unless cut through by some considerable stream.

To avoid confusion, and to prevent associating as identical the cliff limestone of the West with the pentremital limestone, Mr. J. Hall, geologist of the fourth geological district of the State of New York, proposes to substitute for the term *cliff* limestone that of *Niagara* limestone; since this formation exists in the vicinity of the celebrated falls of Niagara, known to all the world, and explored by strangers from all countries. But this, too, is objectionable, since the Niagara limestone only represents a *part* of the cliff limestone; and, indeed, all local terms are objectionable. A name, to be unexceptionable, must point directly to the place in the chronological scale to which the formation designated belongs, or might be derived from some widely distributed fossil peculiar to the rock.

† The analysis of these four specimens resulted as follows:

First specimen. [Taken from a ledge on Lost creek, on the southwest quarter of section 32,

tallized epsom salts, (sulphate of magnesia,) and sixty parts of gypsum, (anhydrous sulphate of lime,) from every hundred parts of the rock. So that, if sulphuric acid can be obtained or produced at a sufficiently cheap rate in Wisconsin, epsom salts may there be manufactured profitably, and to an unlimited extent. I have at present, in my laboratory, two hundred and thirty grains of epsom salts prepared from two hundred grains of the rock.

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township 80 north, range 5 east of the fifth principal meridian—from one of the upper members of the cliff formation.]

Carbonate of lime	51.00	per cent.
Carbonate of magnesia	38.20	do.
Oxide of iron	1.40	do.
Silex	3.70	do.
Water	3.00	do.
Carbonate of soda	1.00	do.
Loss	1.70	do.
	100.00	

Second specimen. [Taken from a cliff immediately behind Dubuque, about 250 feet above low-water mark.]

Carbonate of lime	47.96	per cent.
Carbonate of magnesia	43.00	do.
Oxide of iron	2.00	do.
Silex	3.70	do.
Water	2 00	do.
Carbonate of soda	0.70	do.
Loss	0.64	do.
	100.00	

Third specimen. [Taken from the walls of a lead-bearing rock in Hunt's diggings; and is a very characteristic specimen of the crumbling, sandy-looking rock thrown out of most of the mines.]

Carbonate of lime	47.40	per cent.
Carbonate of magnesia	40.70	do.
Oxide of iron	2.40	do.
Silex	7.10	do.
Water	2.00	do.
Loss	0.40	do.
	100.00	

Fourth specimen. [Building rock, from the lower portion of the upper beds of the cliff formation, taken from the Table Mound, on southwest quarter of section 11, township 88 north, range 2 east of the fifth principal meridian.]

Carbonate of lime	49.00	per cent.
Carbonate of magnesia	39.00	do.
Alumina, with a trace of oxide of iron	1.00	do.
Silex	9.00	do.
Loss by ignition, (chiefly water)	1.90	do.
Loss	0.10	do.
	100.00	

This last specimen, it will be observed, contains a larger proportion of silex than the others. This, however, is the character only of the building strata of the upper beds of limestone, from which the specimen is derived; differing, in this respect, from the true lead-bearing rock of the region. It will be remarked that the carbonate of magnesia and the carbonate of lime, in these specimens, vary little from the proportion of their equivalents. The cliff rock may therefore, if we neglect the incidental ingredients, be considered as composed of one atom of carbonate of lime, and one atom of carbonate of magnesia.

In the first and third of these specimens, the lime was estimated by precipitating it, with oxalate of ammonia, from a solution of the rock in muriatic acid, made previously slightly alkaline by the

It is from magnesian limestone that the epsom salts of commerce are now commonly procured.

But though the cliff rock is a magnesian limestone, and though the proportions of carbonate of lime and magnesia, which chiefly compose it, indicate that it is even a chemical compound rather than a mechanical mixture, yet it cannot with propriety, nor without risk of misconception, be called *the* magnesian limestone, as a late writer* on the geology of upper Illinois has termed the corresponding formation between Chicago and Ottowa; since it is only a subdivision of the protozoic rocks group, always occurring beneath the true coal measures; whereas *the magnesian limestone* of geologists (the *zechstein* of the Germans) is one of the lower members of the new red sandstone group, and *overlies* the bituminous coal formation.

The writer above alluded to had overlooked the fact stated in Phillips's Geology, that "*orthoceratites* and goniatites occur every where in the silurian and carboniferous systems, *and in none which lie above.*"† He, himself, mentions that he found two species of *orthocera*. Besides these, I collected from this formation numerous *trilobites* and *strophomena*, genera which have never been found above the coal measures. These fossil remains supply proof hardly contestible of the geological position of this rock, even had we not had an opportunity, on the banks of the Mississippi, at Parkhurst, of seeing the sandstones, shales, and slaty clays, of the coal formation, resting immediately on the cliff limestone. This discovery places the matter beyond a doubt.

The hard and durable character of this rock in some localities, and its crumbling, sandy, external appearance in others, the imperfect manner in which it effervesces, and its refractory nature in the fire, together with its occasional disposition to imbed chert, and, even in its upper beds, to pass into chert, have doubtless given rise to the idea that it was a compound of sand and lime. Hence, several geologists‡ have been misled to the con-

addition of pure ammonia, and by then converting the resulting oxalate of lime into carbonate, by ignition. The magnesia retained in solution by the muriate of ammonia, formed by neutralizing the muriatic solution with ammonia, was afterwards thrown down in the cold alkaline solution by a phosphate of soda and ammonia; and the magnesia was estimated by calculation from the ignited double phosphate.

The second specimen was dissolved in boiling strong sulphuric acid; the carbonate of lime was estimated from the resulting insoluble sulphate of lime, (gypsum;) and the magnesia from the soluble sulphate of magnesia (epsom salts) retained in solution.

From the nature of this last analysis, it is probably less accurate than the others, since the sulphate of lime is not entirely insoluble.

Although I had always supposed magnesia to be a constituent of the cliff rock, the large per centage of carbonate of magnesia obtained, and the small per centage of silex, were unexpected. I therefore repeated and varied the analysis on several specimens, to be assured that these were the constituents of the rock generally.

Unless this rock is treated with *strong boiling* acid, a large proportion of the carbonate of magnesia remains undissolved, and thus a hasty analysis might fail to detect the actual per centage of magnesia, and lead into error as to the true character of the rock.

* "Geology of Upper Illinois," by C. U. Shepard, M. D., originally published in the "American Journal of Science and Arts," No. 1, vol. XXXIV. See page 9 of the pamphlet.

† The only two exceptions to this general rule--one, the "orthoceras elongatum," discovered by De la Bèche in the lias of Lyme Regis, and termed by Buckland "a small and problematical species;" the other, discovered in the oölite formation at Halstadt, in the Tyrol, cannot be considered to invalidate the above position. No orthoceratites, as an inspection of the various tables of organic remains shows, have ever been found in the magnesian limestone, or any other member of the new red sandstone group.

‡ Featherstonhaugh and Schoolcraft.

clusion that it is a siliceo-calcareous rock. It appears, however, that it generally contains less than four per cent. of silex.

In its mineral character, lithological structure, external appearance, and juxtaposition to the coal measures, it closely resembles the *scar* limestone in the southern part of the mountain limestone group of the north of England. So marked, indeed, is the resemblance in these respects, that, in both countries, a name of similar import, originating with the people, has been adopted by scientific writers. I allude to the *scar* limestone of Sedgwick and Phillips. The latter, in his recent "Treatise on Geology," (forming the article under that head in the seventh edition of the Encyclopedia Britannica,) subdivides the carboniferous limestone group in the north of England into "Yordale rocks, *scar* limestone, and alternating red sandstone and limestone."

De la Bèche, in his "Geological Manual," quotes from Professor Sedgwick, who, speaking of the rock formation in Northumberland and Durham, says: "Under the coal fields we have, in regular descending order, the millstone grit, the alternations of limestone and coal measures, and, at the base of all, the great *scar* limestone. The old English word *scar*, now somewhat obsolete, signifies a cliff; and, as a provincialism in the north of England at this day, it is employed to designate a "steep, rocky, and bare place in hills." *Scar* limestone, then, and *cliff* limestone, are synonymous terms, the most appropriate, perhaps, that could be adopted to describe these rocks, if we have reference to their external appearance alone.

The resemblance between them may be yet further traced, by referring to Phillips's work above quoted. He there says:

"The limestone of Derbyshire, the lower scar limestone of Sedgwick and Phillips, is a great mass of calcareous rocks, almost entirely free from arenaceous and argillaceous admixture." And again, speaking of this same limestone of Derbyshire, he says: "It is worthy of note, that several of its beds are of *magnesian* limestone."

Here the accordance is striking. In the cliff limestone of Iowa, there is, as already stated, but a small per centage of silex; there is little more than a trace of alumina; and it is a true magnesian limestone.

Phillips, in a former work, speaking, as it would seem, of the same great scar limestone of the north of England, which he there calls "the great limestone," says: "It is considered to have produced as much lead as all the other sills put together." This is pre-eminently true of the cliff limestone of Iowa and Wisconsin.

Again: in regard to their geological position, Phillips (in the same article from the seventh edition of the Encyclopedia Britannica, already adverted to) furnishes the following table of the formations in the north of England, considered the richest lead country in the world:

Names of formations.	North of England and Scotland.
Coal formations	Coal, shale, grit, and ironstone.
Transition series	Millstone grit, coal, shale.
Carboniferous limestone formation	Yoredale rocks, { Limestone, gritstone, shale, and coal.
Transition series	Lower scar limestone group.
Old red formation	*Alternations of red sandstone and limestone.*
	Red sandstones and red conglomerate.

A similar table for the district upon which I am now reporting will exhibit the strong similarity of the formations :

Names of formations.	In Iowa and Wisconsin.
Coal formation - - - -	Coal, shale, grit, and slaty clays, with ironstone.
	Cliff limestone.
Sub-carboniferous limestone, or pro-	Blue fossiliferous limestone.
tozoic rocks - - -	*Alternations of red and white sandstones and*
Sandstone formation - -	*magnesian limestones.*
	Red and white sandstone.

An inspection of these tables will show two variations of importance in the succession of strata in these English and American lead regions. The first is, the deficiency in the latter of the strata which, in the north of England, intervene between the true coal measures and the scar limestone; and the second is, the deficiency in the former of the blue fossil-bearing limestone, which, in Iowa and Wisconsin, separates the cliff rock from the alternating sandstones and limestones below.

Yet, even this latter deficiency does not seem to be universal throughout the lead region of England. Pennant says: "At Matlock, in Derbyshire, magnesian limestone, sometimes containing shells, *is incumbent on horizontal strata of shell limestone.*"*

Such is precisely the position of the cliff magnesian limestone of Iowa; for the stratum of blue limestone on which it rests is eminently rich in fossils, and, in parts, is but an aggregation of marine shells.

And, again: even in regard to the strata interposing in England, and deficient in America, between the coal measures and the cliff or scar limestone, we find the following passage in Professor Sedgwick's address to the London Geological Society, 1831: "The lowest portion of the whole carboniferous system, from Bewcastle forest, along the skirts of Cheviot hills, to the valley of the Tweed, has hardly a single feature in common with the inferior part of the Yorkshire chain; but, on the contrary, has all the ordinary external characters of a coal formation. Corresponding to this change, is a gradual thickening of carbonaceous matter in some of the lower groups. Many coal fields have been opened upon this line; and near the right bank of the Tweed (almost on a parallel with the great scar limestone) is a coal field with five or six good seams."

Thus it would seem that, in a portion of the north of England, the true coal measures nearly approach, if they do not come into contact with, the great scar limestone.

We have further, in the two formations, the same alternations at the base of the group. Remarking on these, Phillips says: "The lower part of the group round the Cambrian mountains, and along the Penine escarpments, from Brough to Brampton, contains alternating red sandstone beds, thus constituting a real transition to the next or old red sandstone formation." If we read "a red sandstone" for "the old red sandstone," the remark will apply without any other alteration to the rocks of Iowa and Wisconsin.

* Quoted by Cleaveland, in his "Mineralogy and Geology," page 171.

So striking and numerous were these various points of resemblance, that were it not for the guide furnished by the specific character of the organic remains found in the rocks of Iowa and Wisconsin, one would be strongly tempted to pronounce the *cliff* limestone of America and the *scar* limestone of England as in name synonymous, so in geological character identical.

A review of the fossils of the region under consideration proves, however, that the cliff formation of Iowa and Wisconsin is, in point of fact, the American equivalent of the UPPER, and perhaps of part of the LOWER, silurian formations of Murcheson.

By reference to the lists and figures of organic remains which I am about to furnish, it will be observed by those conversant with the palæontology of rocks, that most of the characteristic fossils of our cliff limestone are closely allied, if not specifically identical, as well with those of the Dudley and Wenlock limestones of the above silurian system, as with those of the Eifel rocks in Germany, of Drummond island in Lake Huron, and the corniferous, Onondaga, and Niagara limestones, and in part, perhaps, of the Champlain division of the New York system, all of which are members of the same protozoic system. And, by a further reference to organic remains of the underlying blue limestone, it will be discovered that many of them correspond closely with fossils of the Caradoc formation in the lower silurian rocks of England, and those of the Trenton limestone and shales of the Champlain division of the New York system.

Thus, since geologists agree that identity of fossils is a guide more trustworthy than any resemblance in mineralogical character or similarity in chemical composition, we arrive at the conclusion that the limestones of Iowa and Wisconsin are cotemporaneous in their formation with the above silurian rocks of England and their equivalents, already mentioned, on the continents of Europe and America.

The lead ore of Iowa and Wisconsin, then, is mined in a rock of somewhat greater antiquity than the scar and other members of the mountain limestone group, which chiefly furnish the lead of England; but it behooves us to remember that the metalliferous capacity of rocks depends rather upon their lithological character than upon their precise age. Phillips, in a recent geological treatise from which we have already made several quotations, justly remarks: "It is not because of any peculiar chemical quality that limestone yields most lead ore on Aldstone Moor, but because it is a rock *that has retained openness of fissure.* Gritstones, in many mining fields near Aldstone Moor, are equally productive; but shales, as being soft extensible layers, have closed up the fissures, and their crumbling faces appear to have rejected the crystallizations which have attached to the harder limestone, gritstone, and chert."

Thus, though the lead-bearing rocks of England and America are not strictly equivalent, they are analogous in those points on which their productiveness chiefly depends. And, so far as difference in age is concerned, the advantage is with the galeniferous rocks of America. All other things being equal, the older the rock, or, in other words, the nearer it approaches the inferior igneous rocks (the presumed sources of metallic ores) the greater is the probability of its being rich in metals.

We have high authority to sustain this argument. Phillips says: "As a general result, we cannot doubt of the far greater prevalence of mineral veins in the older than the newer rocks. Not one case is known of a min-

eral vein being, at any time, worked in any part of the British islands above the new red sandstone. In the new red sandstone and magnesian limestone (above the coal) hardly more than slight traces of such products occur. They are rare in our coal tracts, but they become abundant in the mountain limestone and older strata. But yet it is probable that this relation of mineral veins to the age of deposites is merely a consequence of the more general truth, that their origin is from below; that the fissures which they occupy, and the metallic and sparry matters which compose them, are more numerous near the igneous rocks, which in so many instances form the axis of movement."

Again: De la Bèche, in his "Theoretical Geology," has this remark: "Every Cornish miner knows the value of the proximity of his mine, if it be in *killas*, (as the slates are commonly termed in the mining districts of that part of England,) to granite."

In point of fact, we find that, if we except the principal lead region of England, galena occurs more richly and more frequently in formations older than the mountain limestone than in the mountain limestone itself. The lead mines of Spain, hardly second in productiveness to those of England herself, are found in grauwacke or still older formations. But grauwacke is a term employed to designate rocks of a peculiar lithological character, belonging to the protozoic system. The lead-bearing rocks of Spain, therefore, are at least as old as those of Iowa. Murray, in his "Encyclopedia of Geography," says of these: "The primitive and transition rocks in very different places are rich in ores. The present mines are confined principally to the southwest and southeast parts of Spain. The mighty lead-glance veins of Linares occur in granite; the colossal deposite of lead-glance in the Sierra de Gador, which afforded in the year 1828 600,000 cwt. of lead* is distributed in masses (putzen) in a limestone which may be referred to the oldest transition rocks;" in other words, to the base of the protozoic system. So, also, in the well-known lead hills of Lanarkshire, in Scotland. In the mountains of the Hartz, so rich in metallic ores, lead occurs (as Leonhard, in his "Handbuch der Oryktognosie," expresses it) "auf mächtigen gängen im uebergangs gebirge;" that is, "in immense veins in the transition formation;" which transition formation, in those mountains, consists of grauwacke and grauwacke slates resting on granite.† At Kongsberg, near Christiana, in Norway, it occurs, associated with silver ore in mica slate, older than the silurian rocks. At Feistrets, and elsewhere in Stiria, it is found in grauwacke slate. At Sala, in Sweden, it forms veins in primitive limestone. At Lozère, in France, granular and compact galena, containing silver, runs in veins through gneiss, mica slate, and granite. At Poullanen and Huelgoet, also in France, it is found in similar rocks. At Freiberg, in Saxony, it occupies veins in gneiss.

In fine, except perhaps at Bleiberg, in Carinthia, I know of hardly any

* This amount, say *sixty-seven million pounds*, is about two-thirds the annual produce of Great Britain; but the produce of the Spanish mines, in a country of variable industry and unstable government, is exceedingly fluctuating; and the mode in which the ore occurs (distributed irregularly in nests) adds to this uncertainty. The total produce of these Spanish mines (article "Lead," Penny Cyclopedia) is said to have been—

In 1836	50 million pounds.
In 1837	33½ million pounds.

† There appears good reason to believe that part of the slaty rocks and limestones of the Hartz and of Norway, as well as the Eifel limestones, belong to the protozoic or silurian system.

lead region of importance on the European continent which is not of older formation than the scar limestone of England.*

So far, then, the comparison of the geological character of the lead regions of England and America results more favorably to the latter than if the formations had proved strictly identical.

There is one condition of things, however, in the district of country on which I am reporting, which may be considered unfavorable to the prospects of a mining country. It is the apparent absence *near the surface* of dykes or veins of basalt, greenstone, porphyry, or other igneous rocks. Extensive fissures and irregularities in the dip of the strata we find, but beyond these no decisive evidence of dislocations or of igneous action; no faults, sudden contortions, metamorphic rocks, or similar indications of disturbance or volcanic action. I mention this as an exception to a very general rule. It is not, says Phillips, "merely because of the antiquity of the killas of Cornwall, but of its proximity to granite rocks, that it is so very metalliferous; the limestones of Ireland, undisturbed by any great axis of movement, are very little metalliferous, while the same rocks dislocated, in Mendiss, Flintshire, Derbyshire, &c., yield many sorts of metals and spars, in veins of different kinds. Thus the most general point of view in which mineral veins present themselves is that of dependence on proximity to the sources of subterranean heat. In the rocks nearest these sources, they are most numerous and varied." But it must not be forgotten that the country I hastily surveyed is still new, and that the mining, as yet, has been comparatively superficial. We must not conclude, because no trappean or crystalline rocks have yet been observed, that they do not exist there. Future observations may yet discover these. In Missouri, in a similar formation near the Iron Mountain, and in St. Genevieve county, fourteen miles west of the Mississippi, and in the vicinity of the lead region, dykes of greenstone (diabase) and porphyry have been discovered. And I incline to believe, from the abundance of metallic ores in Iowa and Wisconsin, and the irregularity of the dip of the rocks already described in the northern part of this region, that there also granite or trappean rocks cannot be far off. Indeed, we have every reason to believe that they are in place further north, at the falls of St. Croix.

There is another fact, connected with this subject, which here deserves notice.

The upper sandstone of the Wisconsin river is found of every degree of induration, from that of an incoherent sandstone, crumbling under the pressure of the fingers, to that of a hard quartz rock, giving sparks with steel. The induration of this sandstone would in itself carry with it evidence of igneous action; but, on the other hand, the adjacent superincumbent limestone is, for the most part, full of fossils in a high state of preservation; and in no instance, where it was noticed, does it assume the character of a sparry or metamorphic limestone, and therefore militates against this origin of the structure of this sandstone.

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* Though I am not aware that the Wenlock formation of England furnishes much galena, yet I remember to have read that the town of Wenlock, whence this rock derives its present name, was, about the time of Richard II, famous for its copper mines. On page 214 of "Murcheson's Silurian System," under the head of "Minerals of the Wenlock Formation," we find the following passage: "It is said that there were formerly lead mines in this limestone, near Much Wenlock, but they have been disused for many years."

The limited time allowed for the completion of the survey prevented me from investigating this matter as minutely as I desired. It is a subject, however, which demands the most rigid inquiry, since, in the absence of deep excavations, it is the most important guide to the solution of the problem. Do the lodes of lead ore, after passing the blue fossiliferous limestone, and underlying sandstone again expand in dimensions, and extend downwards through the fissures of the *lower* magnesian limestone? I have thus furnished, so far as an exploration necessarily hasty and imperfect supplies the materials, a sketch of the resemblances and differences between this American lead region and those of Europe, more especially that of the north of England, whence commerce has hitherto obtained by far the greater portion of the lead that fills the markets of the world.

The Peninc chain, already alluded to as the centre of this last lead region, is a range of mountains extending from the borders of Scotland into the centre of Derbyshire; and that portion of it lying between Brough, on the eastern border of Westmoreland, and Brampton, in the northern part of Cumberland, runs through the celebrated *Cross Fell* country, (so called from Cross Fell, the highest summit of this Penine chain.) In a popular article on lead, in the "Penny Magazine" of 1835, we find the following statement, which, from such a source, may probably be relied on: "England produces, annually, nearly three times as much lead as all the other countries of Europe put together. The chief mines are in the north of England, in Derbyshire, North Wales, and Devonshire, on the borders of Cornwall. The great seat of the north of England mines is in that high district around the mountain of *Cross Fell*, where the counties of Northumberland, Cumberland, Westmoreland, the North Riding of Yorkshire, and Durham, meet, as it were, in a central point, and from which they radiate." "The mines in this part of England have yielded of late, on an average, about twenty-five thousand tons of lead annually, which is more than one-half of the whole produce of Great Britain."

It appears, then, that the north of England lead district produces more than ONE-THIRD of all the lead obtained in Europe. It is, confessedly, the richest lead region in the world, unless the Wisconsin lead region may rival and surpass it. I have, for this reason, sought up with care the materials, and here submitted them, for a comparison between the mineral character and the geological formation of that favored mineral region in the old world, and that not less favored, perhaps, to which, in this western portion of the new world, my instructions have directed my attention.

Materials for further comparison are furnished in the following additional details regarding the mineralogical structure, external appearance, specific gravity, and organic remains, of the coralline and lead-bearing of the cliff limestones of Wisconsin.

The external features of this rock have been correctly described by Keating, and correspond, also, to the description by Shepard of the limestone in northern Illinois. When newly fractured, the true cliff rock is usually of a light grayish yellow, passing occasionally into a brownish or reddish yellow, especially when it has been exposed, in cliffs, to the action of the weather. In this latter case, the texture, though it often appears sandy and granular to the naked eye, yet is found, under the microscope, to be made up of minute rhomboidal crystals disseminated over its surface. The fresh fracture exhibits, in addition, a glistening lustre and sub crystal-

line aspect. Though sometimes from exposure liable to crumble into a very fine powder, it is yet, throughout its mass, a solid, hard, compact rock.

Its fracture is sometimes flat, but usually conchoidal.

In many specimens, innumerable minute crystalline facets of calcareous spar may be found distributed throughout the entire mass, and giving to the rock, when held up so as to reflect the light, a brilliant appearance.

The specific gravity of this rock varies from 2.65 to 2.70.

The cliff limestone may be distinguished into—

1. *Upper or shell beds.* A pure white variety of limestone, not magnesian; fossils calcareous. The lightest purple tint on the charts.

2. *Middle or coralline beds.* Yellow magnesian limestones, containing layers and nodules of chert, and indeed passing sometimes wholly into masses of flinty rocks. Fossils mostly siliceous. Stratification generally distinct, containing good iron ore, and much calcareous spar; but lead ore rarely, and in unprofitable quantities. Medium purple tint on the charts.

3. *Lower or lead-bearing beds.* Yellow magnesian limestone; aspect more arenaceous than the coralline beds, though they contain but a small per centage of silex. Cherty masses more rare. Fossils chiefly casts, and of the same nature as the imbedding rock. Stratification imperfect, with numerous vertical fissures. Rich in ores of lead, zinc, and (in the lower part) copper, associated with oxide and sulphuret of iron. A deeper purple tint on the chart, chiefly included within the red boundary line circumscribing the productive lead region.

These several beds are also distinguished by their fossils; but, first, of the

CARBONIFEROUS LIMESTONE OF IOWA.

The only beds I have been able to refer to this period seem to be extremely thin and obscure. About three miles southwest of Rockingham, in Iowa, occur strata of a reddish limestone, abounding in ENTROCHITES and RETEPORÆ, evidently belonging to that era; probably an upper member of that formation, which I have usually designated as the Archimedes beds. Plate No. 11, figures 1 and 2, after page 68, are two weather-worn slabs from the above locality. They display on their surface a variety of ENTROCHITES and RETEPORÆ; also, a TENTACULITES and a new coral CYATHOPORA IOWENSIS, O.

Near Stevenson, Illinois, on the opposite side of the Mississippi, are dark gray encrinital layers, which are also referred to this period.

Though I did not obtain unequivocal evidence of the existence of either of the two characterizing fossils, (the RETEPORA *Archimedes* or PENTREMITE,) I am disposed to believe that some of those reticulated fragments on the slabs belong to the former species, and that a closer search would hardly fail to detect well-defined specimens of that fossil.

This limestone formation is represented on the charts by a narrow band of cobalt blue, skirting the coal measures in the southern portion of the district.

The white limestone of Red Cedar, Wopsinonox, Rock river, and Iowa City, closely resembles some of the beds of carboniferous limestone; and, as it lies near Rockingham and Rock river in close proximity to the beds just described, it was at first supposed to be a part of this formation. But the organic remains collected from this white limestone subsequently proved

to be cotemporaneous with the "shell beds" on the falls of the Ohio, a rock hitherto considered the top of the cliff limestone.

The fossils on plate No. 12, after page 68, are from the formation in question; so, also, is sketch on plate No. 7, figure No. 6, after page 68, which appears to be identical with a coral of the Onondaga limestone, called, in Hall's report, ASTREA *rugosa*. Figure 3, No. 33, (SYRINGOPORA?) of the same report, is also closely allied to a fossil coral very abundant in some localities of this rock near the mouth of Rock river.

An inspection of these figures and of the list of organic remains will show that, in this attenuated calcareous mass of Iowa and northern Illinois, there is an apparent blending together of fossils, which occur in the State of New York, not only in the Onondaga and corniferous limestones, but also in the Marcellus shale and Hamilton group. The most abundant fossils of the coralline beds of the magnesian cliff limestone are—

Silicified chain corals, (CATENIPORA *escharoides*—see plate No. 7, figure No. 2, after page 68,) in greater abundance and in more perfect preservation than I have ever seen them elsewhere. They may be found of every degree of mesh, from that of one inch to one-tenth or one-sixteenth of an inch; and the imperceptible gradation of these meshes shows that no specific distinctions can with propriety be founded on this character.

Catenipora escharoides.

Casts of probably more than one species of PENTAMERUS, (see plate No. 7, figure No. 3, after page 68;) the individuals very numerous.

Mr. T. A. Conrad asserts,* that when these two fossils, CATENIPORA *escharoides* and PENTAMERUS *oblongus*, are associated, they characterize the upper part of the Caradoc sandstone, (Clinton group of New York.) I cannot subscribe to this view of the geological position of these beds of magnesian limestone. A glance at the fossils on plates Nos. 13 and 14, which represent the organic remains occupying the same geological horizon, even though one might fail, in many instances, to establish points of absolute and specific identity, is sufficient, in my opinion, to prove these coralline beds to be the American equivalents of the Dudley and Wenlock limestones of England, and of those limestones of the Eifel and Gothland, which furnished to Goldfuss so many corallines for description and illustration in his "Deutche Petrefacten." Besides, the stratigraphical range of the CATENIPORA *escharoides* is so wide that it renders it an uncertain and unsatisfactory guide in determining nice points of equivalence,† and I am not perfectly satisfied that any of the Iowa and Wisconsin pentameri are the true *pentamerus oblongus*. I still, therefore, adhere to the belief that the coralline beds, at least of the magnesian cliff limestone of Iowa and Wisconsin, belong to the *upper* silurian system.

Pentamerus oblongus and *pentamerus huspodus.*

It cannot be denied, however, that the lower beds of the upper magnesian limestone in Wisconsin do contain some fossils common both to the substrata of blue and gray limestone of that region, and to the Champlain division of the New York system. Indeed, from the extreme attenuation of the strata in the northeast of Wisconsin, which correspond *lithologically*

* Proceedings of the Academy of Natural Sciences of Philadelphia for 1843, pp. 330 and 331

† Dr. Clapp found this coral in sandstone near Attica, on the upper Wabash, which he considered belonged to the coal formation.

with the blue fossiliferous limestones of Ohio and Indiana, there is reason to believe that that formation does actually become, in part, magnesian and lead-bearing in the Mineral Point district of Wisconsin. But since I have not yet observed any distinct, satisfactory, lithological, or even palæontological division in this magnesian lead-bearing formation, I have thought it best to describe the whole under one head.

Plate No. 15 contains fossils taken from rocks quarried while following a lode of galena; and those on plate No. 16 were found on the surface in the region of Wisconsin, where the lowest beds of the upper magnesian limestone prevail.

The organic remains on plates Nos. 17 and 18 are from the substrata of fossiliferous shell limestone, possessing all the essential lithological characters of the true blue limestone of the Western States. There can be but one opinion as to the geological position which these schistose calcareous layers occupy. They evidently belong to the lower silurian period of England, the Champlain division of the New York system, and the blue fossiliferous limestone of the Western States.

Additional fossils, not figured in this work, are, in the *coralline beds:*

MANON *cribrosum.* Goldfuss.
TRAGAS *rugosum?* Munster.
capitatum? Goldfuss.
hypocastanum.
STROMATOPORA *concentrica.*
CYATHOPHYLLUM *dianthus?*
siluriensis?
attenuatum. O.
STROMBODES *plicatum?* Ehr.
pentagonus? Goldfuss.
confluens.
PORITES *tubulata.* Lons.
pyriformis. Ehr. (ASTREA *porosa.* Gold.)
ASTREA *helianthoides?*
geminata. Gold.
oculata. Gold.
SYRINGOPORA *reticulata.* Gold.
bifurcata. Lons.
FAVOSITES *Gothlandica.* Gold.
Var. basaltica. Gold.
fibrosa.
spongetes?
new species.
ORTHOCERAS *annulatum?* with very large syphuncle.
ACTINOCERAS; with double syphuncle.
EUOMPHALUS.

Additional fossils of the blue and gray limestone:

FAROSITES *fibrosa?*
PENTAMERUS *lævis?*
EUOMPHALUS *triliratus.* Con.
TURBO *lenticularis.*
PLEUROTOMARIA *carinatus.*

Turritella.
Subulites elongata. Con.
INACHUS *pervetus.* Con.
ORTHIS *disparilis.* Con.
ORTHOCERAS *annellum.* Con.
CYRTOCERAS *marginale*
ACTINOCERAS.
There are also very large chambered shells, 4 feet long, displaying a curious structure—a series of concentric funnel-shaped tubes.
CALYMENE *senaria.* Con.
CYRTOCERAS *marginalis.* Con.

LEAD MINES.

The extent and position of the lead region may be seen by referring to chart No. 2. (*See plate No. 2, after page 68.*)

The boundary is represented by a red line; and within it are included as well all the productive diggings as the entire region wherein, from the observations made during this survey, there is reason to believe productive lodes of lead may readily be found.

This lead region lies, as will be remarked, chiefly in Wisconsin, including, however, a strip of about eight townships of land in Iowa, along the western bank of the Mississippi, the greatest width of which strip is on the Little Mequoketa, about twelve miles from east to west, and including also about ten townships in the northwestern corner of Illinois. The portion of this lead region in Wisconsin includes about sixty-two townships. The entire lead region, then, comprehends about eighty townships, or two thousand eight hundred and eighty square miles; being about one-third larger than the State of Delaware. The extreme length of this lead region, from east to west, is eighty-seven miles; and its greatest width, from north to south, is fifty-four miles.

The boundary of this region commences on the Mississippi river where the south line of township eighty-seven north, range four east of the fifth principal meridian, crosses that stream, immediately below the mouth of Little Tête des Morts; and runs thence six miles due west; thence, six miles north; thence, nine miles west; thence, three miles north; thence, three miles west; thence, three miles north; thence, three miles west; thence, three miles north; thence, three miles west; thence, nine miles north; thence, six miles west; thence, three miles north; thence, three miles west; thence, three miles north; thence, three miles west; thence, three miles north; thence, three miles west; thence, three miles north; thence, three miles east; thence six miles, or thereby, north, to the Mississippi, which it strikes about seven miles below the mouth of Wisconsin river; thence, crossing the Mississippi, it runs east, to southeast corner of section twenty-one, township five north, range six west of fourth principal meridian; thence, four miles north; thence, nine miles east; thence, three miles north; thence, eighteen miles east, passing along the northern base of the Blue Mounds; thence, twelve miles south; thence, twelve miles east; thence, twelve miles south; thence, six miles west; thence, six miles south; thence, twelve miles west; thence, six miles south, striking the northern boundary line of the State of Illinois at the point where the line between ranges five and six east of the fourth principal meridian crosses

said boundary line; thence, with said boundary line, six miles west; thence, twelve miles, or thereby, south, to the southeast corner of section thirteen, township twenty-seven north, range four east of the fifth principal meridian; thence, six miles west; thence, three miles south; thence, sixteen miles, or thereby, east, to the east bank of the Mississippi river, about five miles below the mouth of Fever river, and about a mile and a half below the place of beginning already designated, on the western bank of the Mississippi.*

This lead region is, in general, well watered; namely, by the Peccatonnica river, Apple river, Fever river, Platte river, Grand river, the headwaters of Blue river, and Sugar creek; and on the Iowa side by the Little Mekoqueta and the lower portion of Turkey river; all of these streams being tributaries of the Mississippi.

The highest points within this region are the summits of the Blue Mounds, two hills of a conical shape, composed of chert and other varieties of flint rock, in the northeast portion of the tract, and rising to the height of one thousand feet above the Wisconsin river. The Platte Mounds, also of conical form, and about six hundred feet high, occupy nearly the centre of the lead region.

These isolated and towering mounds, so conspicuous a feature in the landscape of Wisconsin, are evidence of the denuding action to which, under the crumbling hand of time, the surface of our globe is continually subjected, and which the more durable siliceous masses of these hills of flint have been enabled partially to resist.

It will be perceived, by consulting chart No. 2, plate No. 2, that the northern boundary of the Wisconsin lead region is nearly coincident with the southern boundary line of the blue limestone where it fairly emerges to the surface. No discoveries of any importance have been made after reaching that formation; and when a mine is sunk through the cliff limestone to the blue limestone beneath, the lodes of lead shrink to insignificance, and no longer return to the miner a profitable reward for his labor. Indeed, the small quantities of lead ore which have occasionally been found in the blue limestone occur in veins not much thicker than writing paper, which have insinuated themselves into the slender seams of the stratification. This coincidence between the northern boundary of the productive lead region and that of the cliff limestone is an example of the practical utility and application of the geological and mineralogical divisions of the different formations. Even if not a single shaft had ever been sunk in Wisconsin, it might have been predicted, with probability, that this change in the formation would be strictly accompanied with a corresponding change in the productiveness of the lead veins.

Mr. Carne has observed, regarding the metalliferous veins of Cornwall, that it is a rare circumstance when a vein which has been productive in one species of rock continues rich long after it has entered into another; and this change, he adds, is even remarked when the same rock becomes harder or softer, more slaty or more compact. Hence it was very unlikely that the Wisconsin lead ore, so rich in the cliff limestone, should retain the same rich character in the blue limestone, even had the structure of this last been equally adapted to the bearing of lead.

* A few fractional townships, originally included in my special reports, within the lead region, have been, on re-examination, thrown out, as not strictly belonging to the district which is likely to afford productive veins of lead ore.

It will also be remarked, that the designated lead region is almost exclusively confined to the northern half of the cliff limestone formation of Iowa and Wisconsin; which northern half is occupied by its lower beds. The upper beds (lying in the southern portion of the district) do not, as already intimated, furnish productive veins of lead ore. The crevices in these upper beds seem to be less numerous, and either empty or filled with iron ore, (hydrated brown oxide,) or calcareous spar, (crystallized carbonate of lime,) to the almost entire exclusion of veins of lead.

It follows, from the above observations, that the mines in the northern portion of the district are less likely to be productive to a great depth than those along its southern boundaries, at least until the substrata of blue limestone and underlying sandstone are penetrated.

It follows, also, that, in the southern portion of the district, not included by me in the productive lead region, mines of value may yet be discovered, by sinking shafts through the upper beds of the cliff limestone to the lead-bearing beds beneath, unless, indeed, these lower beds should prove to be beyond the sphere of action where the lead has been produced. This latter contingency is possible; yet the richness of the mines in the southern and western portion of the lead district, (at Apple river and Dubuque, for example,) as compared with some of the northern mines, seems to indicate that the ore may still continue rich in the descending beds. Since, however, this is, as yet, an unsolved problem, and, even if it were solved, as it would require much capital to sink shafts to the necessary depth, and since mines of this depth would doubtless be inundated with water, and require steam engines to drain them, I have not considered it my duty to include this southern portion of the district within the bounds of the productive lead region; although, hereafter, should the easily accessible lodes be exhausted, and the demand for lead rapidly increase, it may become so.

With regard to the magnesian limestone which underlies the blue limestone and sandstone strata, and comes to the surface in the extreme north-eastern portion of the district, its similarity in structure and composition* to the cliff limestone, including its disposition to form vertical fissures, and its probable identity with the rock formation in the Missouri lead region, might induce the expectation that it also would be rich in lead ore. It may be so; but as this formation occupies but a small corner of the district, the examinations were necessarily too limited to enable me to pronounce, with confidence, upon its lead-bearing character.

All the valuable deposites of lead ore which have as yet been discovered occur either in fissures or rents in the cliff rock, or else are found imbedded in the soils or earths which overlie these rocks. These fissures vary from the thickness of a wafer to thirty or even fifty feet in thick-

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* The analyses of this rock showed that one of the specimens is a purer magnesian limestone than the cliff rock itself. The results were as follows:

	First analysis.	*Second analysis.*
Carbonate of lime	43.00	52.40
Carbonate of magnesia	39.40	42.00
Silex	14.50	1.80
Alumina, with a trace of iron	1.80	1.50
Loss by ignition (chiefly water)	1.00	1.70
Loss	.30	.60
	100.00	100.00

ness; and many of them extend to a very great, and at present unknown, depth.

The most common diameter of fissures filled with solid ore is from one to four inches.

In the Apple river diggings, one vein filled up with ore was reported to me as being, where then worked, four feet across; but an experienced miner, living close to the Illinois line, in one of the richest spots in the district, informed me that he had never seen a solid vein continue, for any considerable distance, of greater thickness than one foot.

In the spring of 1828 there was a mass of lead ore found in an east and west crevice, at the Vinegar hill diggings, about thirty-five feet in length, expanding in the centre to the width of six or eight feet, and terminating in a point at each end. It was hollow, and its walls averaged about a foot in thickness, forming, as it were, a huge shell of mineral. This extraordinary natural chamber was cleared out; a table spread within it on the 4th of July; and a considerable company celebrated the national anniversary within its leaden walls, about sixty feet below the surface of the earth.

The formation of caverns, by the occasional expansion of the lead-bearing crevice to a considerable width and height, is not uncommon. The ceiling of such a subterranean chamber is commonly adorned with large, pendant, icicle-like stalactites, which conceal from the eye of the spectator the rich lead ore which they encrust.

A regular vein of ore, half an inch thick, can be worked profitably in a solid rock that requires blasting. But where the crevice is filled with clay or loose rock, a regular vein of but a quarter of an inch will pay well for working.

The fissures which bear productive lead veins generally run east and west; or, rather, a little south of east, and north of west. In but a few instances are they found quartering (say) northeast and southwest. On the west of the Mississippi, the north and south lodes are always very thin; generally not thicker than a knife blade; and are seldom followed, except in *drifting* from one east and west vein to another.

Exceptions to this are found east of the Mississippi. In the neighborhood of Mineral Point and Dodgeville, north and south lodes have been found equally productive with those running east and west.

The downward inclination of these crevices has scarcely any uniformity. The same fissure may have an inclination, for ten feet, of forty-five degrees; the next ten be vertical; then it may be arrested at some particular stratum, and strike off horizontally, between the strata, for from one to twenty feet; when it may again resume its vertical direction. Thus the *hade* of the lead veins is very irregular.

The ore does not, in general, fill the entire crevice, but is commonly surrounded by, and imbedded in, either clay or sand. Crystallized carbonate of lime (calcareous spar) frequently accompanies the ore, and may be considered the veinstone or *gangue* of these lead mines.*

* There are only one or two instances at present known, in Iowa or Wisconsin, where the lead ore is found associated with sulphate of barytes, (near Mineral Point, and at Gratiot's Grove mines;) though this is the most common gangue in Missouri, and in many other lead mines; for instance, those in the Hartz mountains, in the south of Hanover. Neither was the ore found associated with the fluate of lime, (fluor spar,) as in Scotland it frequently is. The only locality of this mineral in these western States is, I believe, near Shawneetown, in the State of Illinois, where it is found along with galena, and perhaps at some of the mines in Missouri.

The most usual position of the ore in the fissures is in detached pieces, most commonly of a cubical form, varying from the size of a pea up to masses of one thousand pounds and upwards in weight. The clay in which it is imbedded is usually ferruginous; sometimes of a jet black, owing to the presence of manganese. Sometimes the ore reposes in a fine sandy looking powder, the result of the decomposition of the rock. A portion of the crevice is also often filled with masses of rock which have fallen from the walls of the fissure.

Though the ore be found, as above stated, usually in detached masses, yet these assume, in the fissure, a certain degree of regularity; often occurring in regularly descending steps, as represented in this sketch, (*see plate No.* 9, *after page* 68,) exhibiting a vertical section of a lead mine, and bringing into view the surface soil superincumbent on the cap rock, below which is shown a longitudinal section of the lead-bearing fissure—the *gangue* shaded dark, and the lead ore somewhat lighter; showing also the mode of *drifting*, and of ascending and descending in the shaft. Although the above is the most common position of the lead ore, it is sometimes found in a solid sheet, compressed between the sills of the crevice, and is then called by the miners "*sheet mineral.*" When found in detached masses, as above described, it is commonly termed by the workmen "*chunk ore.*"

A short time since, while following a vein of lead ore, three miles northwest of Dubuque, the fissure suddenly expanded into a chamber-like cavity, filled with alternate layers of galena, ochreous earth, and spars. Most of the sheets of ore run east and west; one vein, however, near the centre of the cavity, runs north and south, and the ore of this sheet is composed of sulphuret of lead of the most exquisite brilliancy. Its broken surface has all the perfection, smoothness, polish, and reflective powers, of the finest mirror. This chamber alone has been proved to contain at least three million pounds of lead ore, and one million of pounds have been taken from it within the last six months.

The lead bearing fissures frequently do not reach within many feet of the upper surface of the rock, but are overcapped by a thick and solid stratum. (*See plate No.* 9.) Occasionally, however, they extend to the surface, and open externally. At other times, they terminate upwards in a contracted funnel, which alone, chimney like, reaches the surface. It is remarkable, that, though the lead ore is never found attached to the walls of the fissure, it frequently occurs completely imbedded in the superincumbent cap rock.

Much lead is raised from what are called "clay diggings." In these the ore is commonly found in detached fragments, but occasionally in regular sheets; and it is covered up, sometimes to a very inconsiderable depth, by ferruginous clay, sand, or detritus, (crumbled rock.) The ore in these localities appears to have dropped into its present position, in proportion as the rock which originally encased it gradually sunk under decaying influences; and the veins, in some places, have retained their former con-

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The clay, which, with the ore and loose rocks, fills the fissures, appears to render them water tight, and obstructs the flow of water through the rock formation; a circumstance which will be of great importance when the mines are worked deep enough to require draining, as it will divide the lead-bearing rock into water-tight compartments in the same manner as *faults* in other mining districts prevent the influx of water from one mine to another. Were this not so, it would be impossible to keep the mines drained, even with powerful steam engines.

nuity, and may still occasionally be traced horizontally for some distance along the ground where they may be supposed to have fallen, until they dip into a vertical fissure; the upper portion of which fissure, now decayed and gone, they doubtless formerly occupied.

The ore thus found has been denominated *float* mineral; incorrectly, however, if by that term is to be understood ore which has been transported from other distant localities to its present position. *Drop* mineral would have been a more correct expression.

The symptoms of lead ore in Wisconsin are various and important.

Inasmuch as the ore is chiefly found in fissures, whatever indicates the vicinity of a fissure may be considered as indicating also the probable neighborhood of lead ore. Thus, when the outline of a hill presents a sort of bench, or step, or slight undulation, like this, (*see plate No.* 10,) even if but small, and not readily remarked, yet, as indicating a slight slip from an internal rent, it becomes a symptom of lead, which the experienced miner's eye instantly detects. For the same reason, a small longitudinal depression, or miniature ravine, on a hill side, may also be considered a symptom.

Again: sink holes, ranging either in an east and west or in a north and south course, are an indication. So also is a rank growth of vegetation in a linear direction, especially of plants with deep-reaching radicals.

The discovery on the surface of fragments of calcareous spar (crystallized carbonate of lime) is also an indication of lead, that spar being, as already stated, the gangue of these lead mines; but if found in large quantities, as in the southern and western portions of the district, it is an unfavorable sign, as indicating that the fissures are chiefly or entirely filled up with this veinstone, to the exclusion of ore.

The red appearance of the surface, indicating the ferruginous clay in which the mineral is often imbedded, may be considered an indication; though it is not so striking a feature here as in the Missouri lead region. Indeed, the surface signs generally in the Wisconsin lead district are less distinctly marked than in that of Missouri. In some of the spots most productive in minerals, nothing appears but the rich black vegetable mould, with occasional pieces of chert interspersed, and the rock showing itself only occasionally in the cuts of the adjacent streams.

But, of all surface indications, the discovery of (so called) "*gravel mineral*," (small pieces of lead ore,) in connexion with the crumbling and arenaceous appearance of the adjacent magnesian limestone, is the most trustworthy. To this may be added minute dark specks distributed over the rock, often assuming the form of delicate miniature ferns.

One of the few corallines which I detected in the lead-bearing beds is a reticulated fossil, resembling the *coscinopora sulcata* of Goldfuss. (*See plate No.* 7, *figure No.* 5, *after page* 68.) Its presence may be considered a good indication of lead. After a productive lode has once been struck, so uniform is generally the direction of the crevice which contains it, that, by taking its bearing by compass, additional shafts may be sunk without "prospecting," and yet with assurance of striking the lode, even though at considerable distance from the first discovery.

When a miner sets out in search of lead ore, he usually begins by what is called "prospecting;" that is, on those spots where surface or other indications lead him to expect a discovery of ore, he commences digging holes or sinking shafts, usually on the summit or the declivity of a hill.

Should he fail in the first attempt to reach gravel mineral, or to come upon any signs of neighborhood to a fissure, he soon abandons the spot, and begins to dig elsewhere. The ground, in many portions of the lead district, is found riddled with such pits, called, in the language of the Wisconsin miner, "prospect holes." Should he reach encouraging symptoms, or actually strike upon a vein, or upon detached pieces of ore ranging downwards, he continues his labor, often with very great profit.

When, after preliminary examinations, he decides to sink a shaft, with the view of striking a crevice, he is compelled, until he reaches the rock, to wall up the shaft with logs.

These shafts, of irregular form, usually approaching a cylinder, are generally from four to five feet across. Sometimes the rock is soft enough to be quarried with hammer, gad, and pickaxe; at others, it is found necessary to blast it with gunpowder.

The mode of descending is by means of a rope of raw hide, and a common windlass worked by one or two men. (*See plate No. 9, after page* 68.) By the same simple contrivance, the ore is raised to the surface. Sometimes, but rarely, ladders are used to ascend and descend.

When a miner is fortunate enough to discover a productive vein accessible from a hill side, he forms a drift, and very conveniently conveys the ore out in wheelbarrows—of course, at a very trifling expense.

The shafts are sunk in this lead region to the depth of fifty, one hundred, or one hundred and fifty feet. They are usually abandoned as soon as the mine is inundated with water, unless the miner, by drifting (that is, working horizontally) until the external surface of the hill is reached, can readily drain the mine. There is but a single instance in the district where a mine has been prosecuted after being flooded with water, which could not thus be got rid of; namely, at Hamilton's diggings, near the Peccatonnica, where the mine is readily drained by a small steam engine. The water in this mine was struck at the depth of thirty feet, and the mine has been worked with profit thirty-five feet below that point.

In the deeper diggings, the *damp* (carbonic acid gas) sometimes accumulates in such quantities towards the bottom as to render it dangerous to work. This happens chiefly in the hot months of summer, and at such seasons the miners are frequently compelled to discontinue their labors.

The means of ventilation yet employed are very simple. A cloth funnel, its upper portion so placed as to receive the breeze and deflect it into the shaft, is one contrivance. Another is, a common barrel laid on its side, near the mouth of the mine, and provided inside with a rude fan, pivoted horizontally, and attached, by means of a strap, to the windlass employed for raising the ore to the surface. As this turns, the fan inside the barrel also revolves; and as the upper part of the barrel communicates, by means of a canvass tube, with the interior of the mine, the air is drawn up from the bottom of the shaft, and a partial circulation kept up.

The lead ore, which, with a few local exceptions, is alone found or worked in this district, is the *galena*, or sulphuret of lead; the same species of ore from which nearly all the lead of commerce is derived.

One of these local exceptions, however, is to be found at Mr. Brigham's mines, near the Blue Mounds, where carbonate of lead is raised in considerable quantities along with the galena. This carbonate is also found in other portions of the district. It is very easily reduced, more so than the sulphuret, inasmuch as the carbonic acid is more readily expelled than the sulphur.

The ores of this lead region are, in general, remarkably pure,* and free from adhering gangue. In a few localities the sulphuret of lead is intermixed with black-jack, (sulphuret of zinc,) and occasionally with carbonate of zinc and oxide of iron.

The process for reducing the lead ore has of late been much improved. Instead of the old log and ash furnaces, (which consumed the best timber in lavish quantities,) cupola, blast, and reverbatory furnaces, have been introduced, which demand comparatively little fuel; an economy of vast importance in a country scantily timbered, devoid of coal, where wood is often sold at five dollars a cord.

No. II.

STATISTICS OF THE LEAD REGION.

In proportion as I proceeded with the geological survey of the Wisconsin lead region, I became more and more strongly impressed with its great value and rich promise of commercial importance. This conviction urged me to the task of carefully collecting and collating such facts as might supply materials for a comparison between the geological character of this region and that of the richest lead districts in Europe. That comparison has been briefly made in a previous section of this report. So far as it goes, it is in a pecuniary and commercial view highly satisfactory; for the strong similarity between the galeniferous rocks in the two hemispheres furnishes an encouraging item in an estimate of the value of the mineral tract now under examination.

But other and more direct proof of that value yet remains. The statistics of this American lead region, so lately settled; so imperfectly known even now; so inefficiently worked, for lack of force, even in those locations where a cursory survey had chanced upon rich lead veins: these statistics (uncertain though they be) of a country so new and rude, impel us to the conclusion that the Wisconsin lead region may compare, if not in present

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* The analysis of two average specimens of galena resulted as follows:

	1st spec.	*2d spec.*
Sulphur	16.00	14.63
Lead	84.00	85.37
	100.00	100.00
The specific gravity of these ores is	7.52	7.71

In the reduction of sulphuret of lead, great care should be taken, while roasting, never to raise the heat so high as to melt the ore. If the ore be melted before all the sulphur is expelled, it is almost impossible entirely to get rid of the sulphur. Free access of air should be allowed during the roasting process, so as to furnish oxygen for the conversion of the sulphur into sulphurous acid, the form under which it must be expelled from the lead. The melted lead, on the contrary, should not be unnecessarily exposed to currents of air, which, in a state of fusion, rapidly oxidizes this metal.

The analysis of the carbonate of lead gave—

Carbonic acid		16.00
Lead	72.06 } protoxide of lead	77.62
Oxygen	5.56 }	
Oxide of iron		2.00
Insoluble residuum		1 80
Lime		1.00
Water of absorption		1.00
Loss		.58
		100.00.

The specific gravity of this ore is 6.04.

productiveness, at least in future prospects, with any other in the known world.

For a time, my opinion was very unsettled as to the actual amount of lead now annually produced in the district. The merchants of Galena, when the question was put to them, calculated the total in Wisconsin and Illinois (where about nine-tenths of the lead is made) at from *ten* to *twelve* millions of pounds only. Mr. Legate, of Galena, formerly agent of the United States to collect the revenue from the lead mines, thought that a full estimate. But I soon became convinced, even from a particular inquiry as to the amount actually produced at a very few furnaces, that this was far below the truth. I found, for instance, from actual returns, that the lead turned out from the furnaces at *three* diggings alone, (to wit, the Platteville, Snake, and Dubuque,) already exceeded ten millions of pounds. An estimate of the number of miners, collected from the best sources, multiplied by the probable amount of lead raised by each, also showed that the estimates made at Galena must fall very far short of the actual amount produced in this region.

Since my return, I have received several letters in reply to inquiries addressed to the most intelligent smelters throughout the district. These, and the personal inquiries I made in the course of the expedition, enable me to furnish, with considerable confidence, the following statement of the amount produced at *thirty-four* furnaces—not quite three-fourths of the whole number which are at present at work in the district:

Statement exhibiting the amount of lead made at the smelting furnaces in Iowa and Wisconsin Territories, and the northwestern portion of the State of Illinois, in the year 1839, *as reported by the smelters themselves, together with a list of the diggings from which each furnace is supplied.*

No.	Smelters' names.	Amount of lead made.	Species of furnace.
	IN IOWA.	*Pounds.*	
1	O'Farrell	1,000,000	Blast.
2	Waller	1,000,000	Blast.
3	Loramie	600,000	Cupola.
4	Burton	400,000	Blast.
	(All supplied with ore from the Dubuque mines.)		
	IN WISCONSIN.		
5	Parish	666,000	Water blast.
6	Terry	200,000	Water blast.
	(Supplied from Blue river and Centreville mines.)		
7	Brigham	300,000	Reverbatory
	(Supplied from Blue Mound mines.)		
8	Governor Dodge	750,000	Cupola.
	(Supplied from Dodgeville mines.)		
9	Horde	400,000	Cupola.
	(Supplied from Pedlar's creek diggings.)		
10	O'Neal	700,000	
11	McKim	194,610	
12	Jenkins	243,000	Blast.
	(Supplied with ore from Mineral Point mines.)		
13	Rowntree	1,000,000	
14	Morrison & Co.	500,000	

STATEMENT—Continued.

No.	Smelters' names.	Amount of lead made.	Species of furnace.
		Pounds.	
15	Vinegard - - - - - -	1,000,000	
	(Supplied with ore from the Platteville mines.)		
16	Craig - - - - - -	1,314,000	Blast.
17	Taylor - - - - - -	900,000	Cupola.
18	Ham & Co. - - - - - -	1,300,000	Blast.
19	Gays - - - - - -	700,000	Blast.
20	Marshall & Co. - - - - -	850,000	Cupola.
	(Supplied from the Snake diggings.)		
21	Hamilton - - - - - -	400,000	Reverbatory.
	(Supplied from Hamilton's diggings.)		
22	Drummond - - - - - -	1,050,000	Reverbatory.
	(Supplied from White Oak spring mines.)		
23	Pilling & Gregoire - - - - - -	720,000	
	(Supplied from Whitesides or Stumpgrove diggings?)		
24	McNulty - - - - - -	720,000	
	(Supplied from the Shellsburg diggings.)		
25	Stahl & Keely - - - - -	1,502,200	Blast.
	(Supplied from Vinegar hill diggings, &c.)		
26	Brush - - - - - -	1,260,000	Blast.
27	Fuller - - - - - -	1,082,000	Reverbatory.
28	Comstock - - - - - -	594,000	Cupola.
29	Fanesworth & Co. - - - - -	205,190	
30	Hooper - - - - - -	750,000	Blast.
31	Shaw - - - - - -	720,000	
32	Gear - - - - - -	543,400	Cupola.
33	Scales & Co. - - - - - -	700,000	Blast.
	(All supplied from diggings near the State line.)		
34	Cheny - - - - - -	500,000	
	(Supplied from Apple river diggings.)		
	Total at 34 furnaces - - - -	24,764,400	

In addition to the above, I have ascertained that there are at least twelve other smelters, (probably more,) whose furnaces are either in full operation or doing an occasional business, namely: Meeker, on Blue river; Bailly and Dowling, at Mineral Point; Palmer & Co., at Platteville; Smith & Co., near White Oak Springs; Champion, at New diggings; Wann & Co., Patch diggings; Binsinger, at Hardscrabble diggings; and Webb & Co., Green, and Cheny, near Galena.

From these I have no authentic returns, though I have taken some pains, by letters and otherwise, to procure them.

Although many of them are doing a heavy business, yet they cannot, perhaps, safely be averaged as high as those from whom we have actual returns, namely, at 725,000 lbs. each. It might be safe, and is probably below the truth, to average them at half a million pounds each; making, for the twelve, six millions of pounds.

This, added to the amount in the foregoing table, gives, as the total of the lead produced in the year 1839, from the lead mines of Iowa, Wisconsin, and northern Illinois, upwards of thirty millions of pounds.

This result was unexpected by me, yet cannot, I think, be far from the truth. The smelters, so far as I could judge, had no interest in deceiving me, and appeared frank and candid in their statements.

Again: the number of miners in the district is variously estimated at from two to four thousand; not employed, however, on the average, probably more than half their time. The medium between the two estimates (say *three thousand*) may be near the truth.

As to the average amount which each miner can raise per day, it is difficult to estimate it with accuraey.

One of the most experienced miners and smelters in the district writes to me: "Two men ean raise something near five hundred pounds a day, from veins of average riehness. Two men *have* raised as mueh as twenty thousand pounds a day from the richest veins."

At MeKnight's diggings, near Mineral Point, three men (miners from Cornwall, England) were seen by one of our party at work on a vein of three inches thiek, in the solid rock. This did not seem to be considered much more than an average vein; and they were then raising,* on the average, fifteen hundred pounds per day; that is, five hundred pounds each.

It would seem, then, to be a very low and safe estimate to calculate eaeh miner's daily work, on the average, at one hundred and fifty pounds of ore.

Now, supposing that, of the three thousand miners estimated to be at work in the district, one-third are engaged in "prospeeting" and other unproductive preparations, and only two thousand actually employed in raising ore, and that these two thousand work but one hundred and fifty days in eaeh year, we have the following result:

Each miner will raise, annually, twenty-two thousand five hundred pounds of ore.

The two thousand miners will raise, annually, forty-five million pounds of ore; and this, at seventy per cent., whieh is rather below than above the average yield of the galena of this distriet, will give *thirty-one million and a half* pounds of lead as the annual produee of these mines.

If this should still seem an over estimate, I may add a few additional facts whieh came to my knowledge regarding the yield of the Wiseonsin mines. Some of them are unparalleled in the history of mining.

From a spot of ground not more than fifty yards square, upwards of three millions of pounds of ore have been raised.†

A drift in Major Gray's diggings, near Mineral Point, in a crevice twelve feet wide, was filled in with elay and ore. When I was there, nine cubic yards only of the eontents of this crevice had been exeavated; and out of that amount of excavated clay and ore, thirty-four thousand pounds of ore had been obtained.

At the New diggings, near the souree of the west braneh of the Peecatonniea, two men can readily raise two thousand pounds of ore a day, and these diggings are not more than twelve feet deep.‡

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* It may be remarked, that *raising* ore means not only excavating it, but also elevating it to the surface of the earth.

† Communicated by Mr. Drummond, of White Oak Springs, one of the most experienced miners in the district, to whose kindness I am indebted for much valuable information.

‡ The facility with which, in some locations, ore can be raised, is remarkable. Two boys, of twelve and fourteen years old, were seen by us, near Mineral Point, at work, with a tiny windlass and bucket. They had earned a hundred and fifty dollars in the last six months, though they complained of having had "no luck!" in striking a productive lode.

Were the difficulties, and labor, and expense, of raising the ore as great here as they now are in the mining countries of Europe, I doubt whether, in the entire district, a single mine would at present be found in successful operation.

At Hamilton's diggings, in township two, and range five east of the fourth principal meridian, from two and a half to three million pounds of ore were raised from a four-acre lot, working to the water, which was to an average depth of twenty feet.

In township one, range one east of the fourth principal meridian, five thousand pounds of lead ore have been regularly raised per day by two men. On section seventeen of this township, ten thousand pounds have been raised by two men in a day. At Shaw & Gennett's diggings, on section twenty-eight of this township, fifteen thousand pounds have been raised by two men in a day. On the northeast quarter of section thirty-one of this township, two men raised sixteen thousand pounds in a day. On the northeast quarter of section twenty-one, and the southeast of section thirty-two, two men raised regularly three thousand pounds a day. On the southwest quarter of section thirty-two, a lode excavated horizontally from the face of a cliff to a distance of only one hundred and fifty yards, yielded a million pounds of ore, which was carried out in wheelbarrows. And on the northeast quarter of section twenty-eight, ten million pounds of ore were raised from a single lode, hardly extending across the quarter section.*

These particulars were obtained on the spot, from the miners themselves, by one of my sub-agents.

In the above township there are seven furnaces at work. They probably average, in their turn-out, with the furnaces of which the produce has been given above. If so, this township alone produces annually more than five million pounds of lead.

An experienced smelter from an adjoining township writes to me, in regard to the above township: "There are about one hundred and fifty miners generally at work on that township: but I suppose a thousand might find profitable employment."

In the Snake diggings, not extending over more than a township, the number of miners was reported to me at about four hundred. Their produce is probably greater than that of the township just alluded to.

Upon the whole, I cannot resist the conclusion that the foregoing estimate of the amount of lead now produced in this favored region is as likely to be below as above the truth.†

* Some of these rich lodes sell for very high prices. Thomas Harrison struck a valuable lode in the Dubuque district. After raising ore to the amount of ten thousand dollars, he then sold a tract of ten acres, comprising the lode, for sixteen thousand dollars, to Messrs. Jones & Kilburn. From this small lot, these gentlemen cleared thirty thousand dollars over and above the sixteen thousand dollars of purchase money.

† Mr. Legate informed me that the produce of the Wisconsin (then called the Fever river) and Missouri mines, from the year 1823 to 1829, was as follows. As a Government duty was then levied on lead, this statement (based on the smelters' returns) cannot be imagined to exceed the truth.

Year.	Fever River mines.	Missouri mines.
1823	335,130 pounds.	
1824	175,220 "	
1825	664,530 "	380,590 pounds.
1826	958,842 "	1,374,962 "
1827	5,182,180 "	910,380 "
1828	11,105,810 "	1,205,920 "
1829	13,343,150 "	1,198,160 "

If, then, we assume the annual amount of lead obtained at thirty millions of pounds, we are furnished with the data of comparison between the produce of this region and that of the mining countries of Europe.

The amount of lead produced in the island of Great Britain, in the year 1828, was, according to a statement made by Mr. Taylor, in his "Records of Mining," as follows:

North of England mines	56,070,000	pounds.
Derbyshire and Shropshire	10,080,000	"
Devonshire and Cornwall	4,200,000	"
Flintshire and Denbighshire	25,200,000	"
Scotland	2,100,000	"
Ireland, Isle of Man, &c.	1,050,000	"
Total Great Britain and Ireland	98,700,000	"

The exact amount of lead produced in the rest of Europe, I have not, in my library, the means of ascertaining. But, in an article on lead, with many statistical details, given in the Penny Magazine, it is stated that "England produces annually nearly three times as much lead as all the other countries of Europe put together." This would make the annual produce of the rest of Europe about thirty-three millions of pounds.

If these data be accurate, it follows: 1st, that the Wisconsin lead region already produces nearly as much lead as all Europe, with the exception of England; and, 2dly, that it produces nearly one-third as much lead as England, hitherto the great miner for the civilized world.

If such be its actual produce, it is difficult even to set a bound to its capabilities. A thousand obstacles have hitherto opposed its progress. The unsettled character of the country—some of its land not yet in market, and much of the rest engrossed by speculators; the migratory habits of the settlers; until within a few years, the Indian disturbances; and, more recently, the temptations offered by the high wages given in Illinois to laborers on the public works of that State: these, and many other causes, have deranged the regular working even of proved mines, and greatly retarded the discovery of others.

I have already quoted from a letter of an experienced miner, who, after stating that a hundred and fifty men were employed in a certain township, adds, "a thousand might there find profitable employment."

Another gentleman, writing to me from Blue River mines, (where probably the number employed does not exceed that engaged on the above township,) remarks: "There are mineral lands sufficient, already proved as such, to engage profitably a thousand more men in this section of the Territory."

But again: this expedition has furnished data, regarding the depth and durability of the mines, more trustworthy than the mere opinions of any individuals, however intelligent and experienced. In the southern and western portion of the district, the lead-bearing rock, by Dr. Locke's observations, has attained to a thickness of upwards of three hundred feet; gradually becoming thinner as it approaches the northern limits of the district. Now, even in that northern portion where it is thinnest, the mines are not yet in any instance exhausted. It may be safely inferred, that, in the south and west, the supply is, for many years, if not for ages to come, inexhaustible.

Upon the whole, a review of the resources and capabilities of this lead region, taken in connexion with its statistics, (in so far as it was possible to collect these,) induces me to say, with confidence, that *ten thousand* miners could find profitable employment within its confines.

If we suppose each of these to raise daily one hundred and fifty pounds of ore, during six months only of each year, they would produce annually upwards of *one hundred and fifty million* pounds of lead; more than is now furnished by the entire mines of Europe, those of Great Britain included.

This estimate, founded (as those who have perused the foregoing pages will hardly deny) upon reasonable data, presents, in a striking point of view, the intrinsic value and commercial importance of the country upon which I am reporting—emphatically, THE LEAD REGION OF NORTHERN AMERICA.

It is, so far as my reading and experience extend, decidedly the richest in the known world.*

COPPER ORE.

The copper ore of the Wisconsin Territory forms an item in its mineral wealth, which would be considered of great importance, and would attract much attention, but for the superior richness and value of the lead, the great staple of the Territory.

This ore occupies, in the district under examination, the same geological position as the lead ore. It originates in the fissures of the cliff limestone. It has been spoken of, very incorrectly, as "float mineral;" as if, like the fragments of native copper sometimes found in the diluvium of Western America, it had been conveyed to its present situation from a distance. This our examinations have disproved. Discoveries of copper ore have indeed been made on a sloping hill side near Mineral Point, within three or four feet of the surface; and there the ore was found disseminated and imbedded in an ochreous earth.† But on following this deposite to the opposite side of the ravine, (on section twenty-two, township five, range three east of the fourth principal meridian,) the copper ore was traced into a crevice, and a regular vein has there been worked to the depth of thirty or forty feet. The pieces of copper ore raised on this spot commonly weighed from a few ounces to ten or twelve pounds; and one mass thence procured was estimated at five hundred pounds.

The course of this copper vein is from southeast to northwest; and if this line be produced, either way, from the discoveries at Mineral Point, it

* The correctness of the above estimates (made by me in 1839) has been since fully proved by the register kept since 1841, at Galena and St. Louis, of the amount of lead shipped and received from the upper Mississippi mines during the years 1841, 1842, and 1843. It shows, also, a steady and gradual increase in the produce of these mines.

Year.	Pigs of lead.	Pounds of lead.
1841 - - - -	463,404	32,438,280
1842 - - - -	473,699	33,158,930
1843 - - - -	581,131	40,889,170

† This earth frequently contains particles, more or less numerous, of copper ore, and is then popularly termed "gozzin," and employed as a flux in the copper furnaces. The gozzin of Wisconsin yields, by analysis, from 6 to 9 per cent. of pure copper—a large per centage for such ore.

will strike, almost exactly, the discoveries of copper ore northwest on Blue river, and southeast on the Peccatonnica—a proof that the copper ore is not a superficial and vagrant deposite, but exists in veins of uniform bearing; and that these veins are continuous, and in all probability extensive.

It is found in several localities in sufficient abundance to repay well the labor of the miner. If there were a steady demand for copper ore in the Territory, the miners could afford, as I was informed by themselves, to raise copper ore at the same price as lead ore, namely, from one and a half to two cents per pound. It would be in good demand, and be extensively raised, but for the capital and skill necessary to reduce it; which are both far greater than the lead smelter requires; and, also, but for the scarcity of fuel. The copper ore of this region compares very favorably with the Cornwall copper ores. An analysis of a selected specimen of the *best* working Cornwall ore, and of three *average* specimens of Wisconsin ore,* showed that the latter contains from a *fifteenth* to a *third* more of copper than the former.

The Wisconsin ore is of a very uniform quality. There was shipped from Ansley's ground, within a mile of Mineral Point, in the year 1838, to England, fifty thousand pounds of ore; which yielded (according to the statement of one of the gentlemen who shipped it) over twenty per cent. of pure copper. The average produce in the copper mines of Cornwall may be stated at eight per cent.

There have been raised, at the Mineral Point mines, upward of a million

* *Comparative analysis of three* AVERAGE *specimens of the solid copper ore from Wisconsin, and one specimen from Cornwall of what is there considered the* BEST *quality of copper ore.*

	Wisconsin.			Cornwall.
	1st spec.	2d spec.	3d spec.	Specimen.
Copper	23.0	24.32	35.7	21.60
Carbonic acid	8 0	8.20	10.0	
Combined water	9.0	9.10	10.0	
Water of absorption	2 0	2.00	–	2.00
Iron	26.5	23.00	15.7	28.88
Oxygen	9.8	12.00	7.0	
Sulphur	5.1	4.00	8.0	24.50
Silex	5.9	7.50	13.0	12.70
Residuum left after the above substances were separated, composed of lime, magnesia, with about 1 per cent. of alkali, and a trace of alumina	10.2	8.00	a trace.	10.00
Loss	.5	1.88	.6	.32
	100.0	100.00	100.0	100.00

Specific gravity of Wisconsin ore from 3.692 to 3.866.
Do. do. Cornwall " 3.564 to 3.595.

If we consider the earthy residuums as accidental, it appears from these analyses that the Cornwall ore is a compound of sulphuret of copper (probably a di-sulphuret of copper) and sulphuret of iron; and that the Wisconsin ore is essentially a hydrous di-carbonate of copper, (the malachite of mineralogists,) composed of one atom carbonic acid, two atoms oxide of copper, and one atom of water, with a variable admixture of the oxides of iron, and little sulphuret of iron. In the third specimen there appears to be but little admixture of oxide of iron; that being replaced by a small per centage of sulphuret of copper.

and a half pounds of copper. At Ansley's copper furnace, one hundred and thirty-five thousand pounds of this was smelted; which yielded, "in a very imperfect smelting furnace," twelve thousand pounds pure copper, or about nine per cent. Mr. Ansley stated that he had not been able to procure a smelter acquainted with the mode of reducing copper ore; and it is impossible to say what the per centage might have been, had the reduction been conducted with skill, and in a well-constructed furnace.

The copper mines of Europe occur in crystalline, metamorphic, and primary fossiliferous rocks; the richest, those of Cornwall for example, chiefly in the latter. The Wisconsin copper veins are found in a formation belonging indeed to the primary fossiliferous group, but yet not strictly coeval with the copper-bearing rocks of England. These latter are included in killas, slaty rocks—the lowest of the stratified rocks of Cornwall—while the copper ore of Wisconsin occurs a little higher in the series, though probably still in the same system, for the cambrian rocks are now no longer recognised as distinct from the silurian type.

It has been already stated, that the dip of the rocks throughout the district on which I am reporting is southerly; and that, on the north, the older and inferior rocks come to the surface. It is in that direction, therefore, that we must look for igneous, metamorphic, and crystalline rocks, as well as those strata the true equivalents of the copper-bearing rocks of Cornwall. So far, then, as geological identity of formation supplies a clew to the metalliferous character of rocks, *we may expect to find the copper veins become richer towards the north.* This inference is strengthened by the reports which reach us of numerous indications of copper in the northern country towards Lake Superior, and by the occurrence of masses of native copper in the diluvium of the Western States, which appear to have been transported with the associate erratic materials from that direction.

One of the difficulties which here occurs in reducing the ore (namely, the lack of fuel) is common to the richest copper countries in Europe. The Cornwall copper ore is conveyed partly to Swansea and other portions of Wales, and partly to Liverpool, to be smelted in a coal region; and the same vessels which thus convey the less bulky material to the more bulky, (the ore to the fuel,) return laden with coal to supply the numerous and powerful steam engines required, for draining and other purposes, at the Cornwall mines. And thus, in Wisconsin, if copper ore be raised in quantities, it may be necessary to convey it south, to the margin of the great Illinois coal field—say to the mouth of Rock river. This would require a land carriage of from ten to thirty miles, and a water carriage of about one hundred. The Cornwall ore is transported to a greater distance than this.

It may be added, as an additional fact whereby to estimate the value of the Wisconsin copper ore, that, in some of the European copper mines, "the ore does not contain above three per cent. of pure copper, and yet it pays for working;" also, that, in some of the Cornwall mines, the ore is worked profitably at a depth of more than two thousand feet "from the grass," as the phrase there is.

Finally, the Wisconsin copper ore derives additional value in consequence of being found in the vicinity of, and often in the same mine as, productive veins of

ZINC ORE.

This ore, found both in Iowa and Wisconsin, usually occurs in the fissures along with the lead. It is chiefly the anhydrous carbonate of zinc of the mineralogist. Though a solid ore, it has an ochreous, earthy aspect, often resembling the cellular substance of bone; hence it is familiarly known among the miners by the name of "dry bones."

Notwithstanding its intrinsic value, which will before very long be duly appreciated, it is at present an object of especial aversion to the miner of Iowa and Wisconsin. It frequently happens, in both Territories, that the lead ore in a fissure gradually diminishes, and eventually is entirely replaced by this zinc ore; or, as the disappointed workman, sometimes with a hearty curse, not very scientifically expresses it, "the dry bone eats out the mineral."

At some of the diggings, large quantities of this carbonate of zinc can be procured. Thousands of tons are now lying in various locations on the surface, rejected as a worthless drug—indeed, as a nuisance. It is known but to a few of the miners as a zinc ore at all. An analysis* of this ore proves it to be a true carbonate of zinc, containing forty-five per cent. of the pure metal.

Sulphuret of zinc (sometimes called *blende*, and by the English miner "black-jack") is also abundant in the Wisconsin mines. It contains from fifty-five to sixty-five per cent. of zinc, but is more difficult of reduction than the calamine.

Sheet zinc is becoming an article of considerable demand in the market, for culinary purposes, and as a covering for valuable buildings, instead of lead. But the chief consumption of this metal is in making *brass*, well known to be a compound of copper and zinc. In this process, the carbonate of zinc, previously calcined, is mixed with charcoal and granulated copper, and then exposed to a suitable heat. The common brass imported from England contains upwards of thirteen per cent. of zinc; that of Paris a little less; and the fine brass of Geneva, used in the nicer parts of watch-making, contains as much as twenty-five per cent. of zinc.

Large quantities both of copper and zinc are now imported from Europe into the United States, to supply the continually increasing demand for brass. It is not improbable that the district now under consideration might furnish of both metals a sufficient amount, at least for many years to come, to supply the entire United States with brass of home produce and manufacture.

Of zinc, at least, there is assuredly a sufficient supply, not only for that

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* Resulting thus:

Carbonic acid	31.00
Protoxide of zinc	56.70
Silex	1.00
Oxide of iron	5.00
Alumina	5.00
Water absorbed after pounding	1.00
Loss	.30
	100.00

Or, if the iron, alumina, and silex, be regarded as accidental mixtures, the ore is an anhydrous carbonate of zinc, composed of one atom of carbonic acid, and one atom of oxide of zinc; or, as it is sometimes called, electric calamine. It contains upwards of *forty-five* per cent. of metallic zinc. Its specific gravity is from 3.77 to 3.89.

purpose, but also for exportation. All the zinc now produced in Great Britain is trifling in quantity, and quite insufficient for the demand; so that a large quantity is imported annually into that island, chiefly from Germany and Belgium. The importation of zinc into England, in the year 1833, exceeded six millions and a half of pounds—a fact which may give us an idea of the importance of this metal as an article of commerce.

Among the productive mineral resources of Iowa and Wisconsin, the at present despised zinc ore may claim no contemptible rank.

IRON ORE.

The iron ore of this district is of excellent quality, and in unlimited abundance. I explored a few years since, in company with Professor Troost, geologist of Tennessee, the iron mines of that State, which already furnish iron to a considerable portion of the Western States. And though I have seen no proof that iron exists in Iowa and Wisconsin, in deposites as extensive as in Tennessee, yet the locations of iron ore are as numerous, and the quality of the ore in general is as good.

In some of the townships, especially in the lower magnesian limestone, on the Wisconsin river, iron ore was found scattered in innumerable fragments over the entire surface. Near the Mekoqueta, my sub-agents reported the discovery of large masses of iron ore, occurring over a very considerable district of country. The reports and specimens from that portion of the district induce me to believe that there iron ore can be found, *on the surface alone*, sufficient to supply several iron furnaces for years to come.

Some of the specimens from these localities are the richest and most beautiful variety of pipe ore I have ever seen, exhibiting a miniature resemblance to the basaltic columns of Staffa, or the Giant's Causeway.

Much of it is the *hematite*, the purest and most productive form of the hydrated brown oxide.*

In many of these locations, where iron ore is found in abundance, fuel, water power, and the limestone for flux, are at hand. In the northern portion of the district, however, the scarcity of fuel presents a serious obstacle to the establishment of productive iron works.

In Dr. Locke's report, under the head "magnetical node," will be found an interesting account of a remarkable magnetical phenomenon, which seems to indicate the presence of some enormous mass of iron, or (if the expression be allowed) some "subterraneous iron mountain," which may resemble, except in position, that of Missouri. The locality indicated is on the Wapsipinecon; and the axis of this node, as Dr. Locke's chart shows, is near the line dividing townships eighty-two and eighty-three, and about six miles west of the fifth principal meridian.

The utility of magnetical observations on the dip and intensity of the needle, as an indication of the presence of protoxide of iron, and perhaps, also, of great masses of the brown oxide, is indisputable; and I consider myself fortunate in having been able to add to the other materials whereby to decide the value of the various locations of mineral lands in this district, the delicate and varied experiments of Dr. Locke.

The variation chart appended to that gentleman's report shows a striking difference in the variation of the needle within a very short distance; and

* These ores of iron yield from 40 to 60 per cent. of the metal.

the *greatest* variation corresponds, in a remarkable manner, with the best locations of iron ore of which actual discoveries were made. If from this we may conclude that the variation is increased by the presence of large masses of ore, the above chart would usefully guide a further examination after the localities of iron ore in the district. It must, however, be remembered, that it is the protoxide which chiefly acts upon the needle, and that the same phenomenon may possibly be caused by comparatively small veins of that variety, as by a large mass of the brown oxide.

The richness of the iron veins in this district cannot be correctly known until mines shall actually be opened; which has not yet been done in any part of it. But more encouraging or more numerous surface indications of an abundant supply of this useful metal can hardly offer themselves to the notice of the geologist. In a country more thickly settled, and with skill and capital to spare, these would speedily cause and justify the employment of whole villages of workmen.

To incidental causes alone, and not to any natural deficiency of material, must be attributed the custom of importing annually from England, into this country, millions of dollars worth of iron for railroads and other purposes. Enormous as is the produce of Great Britain's iron furnaces, (amounting, in 1833, to *fifteen hundred millions* of pounds,) we might rival it in America. How little, here in the West at least, we have hitherto improved our natural resources in this branch of commerce, is proved by the thousands of tons of rich iron ore which lie, unappropriated and useless, scattered over the Territories of Iowa and Wisconsin.

COAL.

An inspection of plate No. 4, after page 68, will show how the great coal field of Illinois extends its northwestern margin over ten or twelve townships of the district, chiefly on the western side of the Mississippi.

One seam of coal only was discovered cropping out west of the Mississippi; and that was of indifferent quality, lying in the north half of section twenty-seven, township seventy-eight, range four east of the fifth principal meridian, on Duck creek. Several were found in the tongue of land which lies in the fork between Rock river and the Mississippi; one of them from five to six feet in thickness. The quality of this last is fair; and, in proportion as the coal diggings extended, the quality improved.*

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* An analysis of two average specimens of coal—one from Duck creek, the other from the eastern bank of the Mississippi, near the mouth of Rock river—resulted as follows:

Examination of the Duck creek coal, from northwest quarter of section twenty-seven north, range four east of the fifth principal meridian—two feet exposed:

Specific gravity - - - - - - - - - -	1.27
Volatile matter - - - - - - - - - -	44.00
Carbon in coke - - - - - - - - - -	48.50
Yellow ashes - - - - - - - - - -	7.50
	100.00

100 grains of nitrate of potash required 24 grains of this coal for complete decomposition. Calculating the amount of pure carbon necessary to decompose 100 grains of the same nitre at 12 grains, this would indicate about 50 per cent. of carbon, and leave about 42.5 of bitumen and volatile gases.

Several good seams of coal show themselves south of the district, within a short distance of its southern boundary; and there is no doubt that any required quantity of this fuel may be procured at no great distance from the mouth of Rock river, which stream enters the coal field about 23 miles above its mouth, and has several good seams exposed in the banks.

The coal in this vicinity is sure to become valuable, and to be in great demand, for the reduction of such ores (especially copper ores) as are raised in those portions of the district which are deficient in timber. Some town in this neighborhood, or a little farther south, is destined to become the *Swansea* of Wisconsin, and to receive, in its numerous furnaces, the rich prodcce of the prairie mines from the north and northwest.

SALINES.

Throughout the Western States generally, no productive salines are found below the true coal measures. They commonly occur in some of the lower members of the coal formation, especially in the white sandstones lying within that formation, and at no great distance from its margin. Such are the well-known saliferous rocks on the Kenawha and Muskingum.

As soon, therefore, as the character and extent of the geological formations in the district were ascertained, I ceased to expect the discovery of any productive salines, except, perhaps, in the extreme southern corner of the tract, where the great coal field of Illinois stretches its lowest members over a few townships.

Every surface indication confirmed my expectations. No salt springs, not a single salt lick, no variegated shales, not one of the usual indications of salt, were discovered. Even in the southern townships, within the coal formation, the thickness of the strata is so inconsiderable that the chance is very slender of reaching profitable brine. Salt, therefore, cannot be reckoned among the productive minerals of Iowa and Wisconsin. It may probably be obtained along the head waters of the western and northeastern tributaries of the Illinois river.

BUILDING STONE.

I was for a time in doubt in regard to the value of the Wisconsin limestone as a building material. Where it has numerous nodules of chert distributed throughout its mass, it weathers unequally, the nodules become detached, and its beauty and value as a building rock is much lessened. This occurs chiefly in the superior portion of the upper beds; that is, over the southern portion of the surveyed district.

Much of the limestone that is taken from the diggings crumbles, also, on being exposed to the weather; yet a portion of the formation will yield

Examination of the Rock river coal:

Specific gravity	1.34
Volatile matter	44.5
Carbon in coke	45.5
White ashes	10.0
	100.0

100 grains of nitrate of potash required 24 grains of this coal for complete decomposition, indicating about 50 per cent. of charcoal, and about 30 per cent. of bitumen. This coal resembles the slaty cannel coal in its composition.

some of the best quarries in the world, and several excellent ones are already opened; for example, on the Sinsinnewa Mound, at Mineral Point; at the Four Lakes; and (but not so good) on the Peccatonnica. This excellent building stone chiefly occurs in the lower portion of the upper beds of the cliff limestone, and also in the lower beds of the "Missouri limestone." It is of a beautiful uniform light yellow color, compact, fine-grained, sharp-angled, capable of receiving a handsome finish, and, if well selected, calculated to endure, uninjured, for ages. It is very readily quarried in square blocks from six inches to a foot in thickness; can be obtained, however, double or treble that thickness, and of any required horizontal extent. The labor of quarrying is light, in consequence of the rock being exposed in cliffs, so as to preclude the necessity of excavation.

In a recent geological notice from England, it is stated that Mr. De la Bèche, in conjunction with Mr. Barry and the veteran father of English geology, (William Smith,) had been intrusted by the British Government with the care of selecting the material of which the new houses of Parliament were to be constructed; and after a tour, made in the course of last year for this express purpose, to the points where the best building stones were supposed to be quarried, they made choice of the *magnesian limestone* of Yorkshire, remarkable for the durability of its color, texture, and sharpest forms, as exemplified in the noble old churches of that country. But this magnesian limestone of Yorkshire, thus selected by some of the most experienced geologists in the world as the best building stone in England, is, as we have already shown, not the equivalent of the cliff limestone of Wisconsin, but a rock of the same lithological character. The inference is, that some of the strata of the cliff limestone of Wisconsin may be expected to furnish building materials of a quality the most superior.

The canal engineers on Rock river complained much that they could find no durable building stone, having quarried in the *white* limestone which occurs at the margin of the great coal field. This rock (at that point at least) is little suitable for building purposes. Had these gentlemen ascended the Mississippi to the high land above the Mekoqueta for material, they would have found quarries of the building stone above described, and their locks might have bid defiance to the ravages of time.*

Near Iowa City, and in several other localities along the region colored on the charts of the lightest purple tint, where the previously described white limestone prevails, that rock is frequently studded with a beautiful fossil coral, represented in plate No. 7, fig. 6, after page 68. This is the so-called "Iowa City marble." It forms a very beautiful material for small ornamental purposes; but, as its beauty depends on the occurrence of this isolated coral in the limestone, it is not likely that it will afford extensive marble quarries. One of my sub-agents found a settler building his milk-house of this showy material, in which another coral, the CYATHOPHYLLUM? of Goldfuss, was intermixed with the above fossil.

STYLINA? Lessueur.
ASTREA rugosa. H.

* Even within a much shorter distance, to wit, at the mouth of Quarry creek, where the cliff limestone first makes it appearance in bluffs on the Mississippi river, (on the southwest quarter of section 26, township 79 north, range 5 east of the fifth principal meridian,) they might have found very good building material. This rock, in its external appearance, much resembles freestone, and was reported to me as such by my sub-agents. If it was seen by the Illinois engineers, they may possibly have rejected it from a similar error. Analysis, however, proves it to be a true magnesian limestone.

MILLSTONES.

In section twenty-two, township eighty-nine, range three west of the fifth principal meridian, the United States surveyors had reported a "millstone quarry." There seems, however, to have been no better foundation for this report than the presence of some granite boulders, very numerous on the northern portion of the eastern boundary of the district, and also throughout the western ranges of Iowa. These erratic boulders constitute a peculiar feature in the prairie scenery, and are often of great size. One was reported to me by a sub-agent, somewhat indefinitely, as being "as large as a steamboat." A smaller one, afterwards measured, was eight feet high, and ninety feet in circumference. They are composed of granite, greenstone, porphyry, and other primitive rocks.*

Similar boulders, in the State of Illinois, are, in default of more suitable materials, sometimes employed to make millstones; but the labor of the manufacture from these primitive rocks is very great, and a "millstone quarry" of such a character cannot be considered of value.

In the course of a geological reconnoissance of the State of Indiana, (which, as geologist of that State, I had, two years since, occasion to make,) I found good millstone quarries in a rock formation which is the equivalent of that of Wisconsin, and I had hoped to make similar discoveries in the course of this survey; but I have seen no rock, either in Iowa or Wisconsin, which combines hardness and porosity enough to render it suitable for this useful purpose.

OTHER MINERALS.

No minerals of much value, except those described in the preceding sections, were detected in the district.

Chalcedony, agate, jasper, and cornelian, were found, but not in great perfection.

On the southwest quarter of section seventeen, township eighty-four, range five east of the fifth principal meridian, in the Mineral Point and Blue river lead mines, besides several other localities, was found a white rock, which, by disintegration, forms a white plastic material used in the manufacture of porcelain: it is a hydrate of silica, containing a small per centage of alumina, and is similar to that substance which forms what are misnamed the "chalk banks," below Cape Girardeau, Missouri. If obtained in sufficient quantities, it would be of value in the manufacture of porcelain; but I failed to discover any extensive or continuous stratum of this mineral. It has too large a per centage of silex, and too little alumina, to rank as a true *kaolin*.

No appreciable quantity of silver was discovered in any of the ores of lead subjected to analysis; neither was any sulphuret of silver (as it occurs in the lead mines of the Hartz) found in this district.

In one or two specimens of galena, vestiges of arsenic were detected.

Little or no antimony is found in combination with the lead ore of this district; a circumstance which increases the value of the ore, for lead ore contaminated with antimony is of difficult reduction.

* They are much more frequent towards the heads of the streams than they are near the Mississippi river. In crossing the line between ranges seven and eight of the fourth principal meridian, they commence very abruptly, and are found in great numbers, and sometimes of very large dimensions.

At McKnight's diggings, at Mineral Point, there occurs along with the galena the "black lead ore" of the mineralogist, which is the carbonate of lead with a small admixture of sulphuret of lead.

Crystals of the sulphato-tri-carbonate of lead have been obtained from some of the diggings in Wisconsin.

Manganese, a metallic oxide, useful in various manufactures, was found (but not in a pure form, nor in very large quantities) among the earthy materials in the fissures of the cliff limestone.

In some of the richest lead mines, very fine specimens of crystallized iron pyrites are associated with the sulphuret of lead—some of it (capillary pyrites) brilliant and delicate beyond any I had ever before seen. It is composed of fasces or clusters of silk-like threads, of a pale golden-yellow color, which may be readily separated with the point of a knife.

SOILS.

An item in my instructions required me to report "such facts as will serve to convey some idea of the value and productiveness" of the district under consideration.

In obedience to this instruction, I have analyzed, with care, the soils of Iowa and Wisconsin; and the result of this analysis, extended to fifteen different specimens selected from the various parts of the district, is truly remarkable.

It is a common and usually a correct remark, that mineral regions are barren and unproductive. "If a stranger," as Buckland has well expressed it in the opening of his Bridgewater Treatise, "if a stranger, landing at the extremity of England, were to traverse the whole of Cornwall and the north of Devonshire, and, crossing to St. David's, should make the tour of all North Wales, and passing thence through Cumberland, by the Isle of Man, to the southwestern shore of Scotland, should proceed either by the hilly region of the border counties, or along the Grampians, to the German ocean, he would conclude, from such a journey of many hundred miles, that Britain was a thinly-peopled, sterile region, whose principal inhabitants were miners and mountaineers."

Not so the traveller through the mining districts of western America. These afford promise of liberal reward, no less to the husbandman than to the miner; and a chemical examination of the soils gives assurance that the promise will be amply fulfilled.

The mode of analysis adopted was, in its general features, the same which has been recommended by Dr. Dana, of Lowell, and adopted by the geologist of Massachusetts. I have carried it out, however, in regard to the salts found in the most interesting specimens, into more minute detail than that simple and practical, rather than rigidly accurate, mode of analysis presupposes.

The following table, with the appended notes, exhibits, with sufficient accuracy for practical purposes, the proportions of organic and of earthy matter, the per centage of saline ingredients, and the specific gravity, of each specimen of soil. The specimens were selected from the different formations—chiefly, of course, from the cliff limestone: they were taken from about six inches below the surface, and, with a single exception, (No. 13,) from wild lands. They may be considered a fair average of the virgin soils of the district.

No.	LOCATION.	Loss by baking.	Organic matter soluble in alkali.	Organic matter insoluble in alkali.	Salts soluble in water.	Salts soluble in diluted muriatic acid.	Aluminous residuum.	Siliceous residuum.	Specific gravity.
	Wisconsin soils.								
1	Prairie valley soil from east half of township 5 north, range 6 east of the 4th principal meridian.	6.5	6.0	6.0	3.0 prot and per-oxide of iron, lime, and magnesia.	1.0 chiefly oxide of iron -	0.0	75.0	1.30
2	Section 34, township 4 north, range 4 east of the 4th principal meridian.	0.6	3.0	0.3	0.9 lime, and a trace of magnesia.	0.8 - - -	1.0	93.0	2.32
3	Northwest quarter of section 15, township 5 north, range 1 west of the 4th principal meridian.	4.5	5.5	6.0	2.0 - - -	1.0 - - -	0.0	80.0	1.44
4	Northeast quarter of section 7, township 2 north, range 1 east of the 4th principal meridian.	2.5	5.0	5.0	2. 1.5 muriate of lime, a trace of magnesia.	0.7 - - -	0.0	84.0	1.80
5	Township 22 north, range 6 east of the 4th principal meridian.	3.0	6.5	5.0	3. 1.5 oxide of iron, a little lime and magnesia.	0.5 - - -	0.0	82.0	1.68
6	Rich valley soil on Platte river, from section 33, township 4 north, range 2 west of the 4th principal meridian.	7.5	11.0	15.0	4.5—0.5 oxide of iron, 2.0 lime, 0.3 magnesia.	1.5 - - -	0.0	60.0	1.24
7	Soil from one of the townships richest in lead ore, viz: township 1 north, range 1 east of the 4th principal meridian.	3.5	5.5	5.0	2. oxide of iron, lime, and magnesia.	1.0 - - -	0.0	83.0	1.64
8	Section 22, township 7 north, range 4 west of the 4th principal meridian.	3.5	7.5	6.0	2. 1.5 muriate of lime.	1.0 - - -	0.0	79.0	1.66
9	Northeast quarter of section 8, township 6 north, range 3 west of the 4th principal meridian.	4.0	2.0	7.2	1.8 - - -	1.5 chiefly oxide of iron; no phosphoric acid could be detected.	0.0	83.0	1.92
10	Section 8, township 6 north, range 8 east of the 4th principal meridian.	1.5	0.5	0.5	1.5 oxide of iron, a trace of lime and magnesia.	0.5 - - -	0.0	95.0	2.82

IOWA AND WISCONSIN SOILS—Continued.

No.	LOCATION.	Loss by baking.	Organic matter soluble in alkali.	Organic matter insoluble in alkali.	Salts soluble in water.	Salts soluble in diluted muriatic acid.	Aluminous residuum.	Siliceous residuum.	Specific gravity.
	Iowa soils.								
11	Soil from the west side of Dubuque, from a flat valley	3.5	4.5	6.5	3.5—1.3 lime, 0.3 magnesia, 0.8 oxide of iron.	0.5 chiefly oxide of iron -	0.0	81.0	1.62
12	Southeast quarter of section 25, township 89 north, range 2 east of the 5th principal meridian, from the ridge.	3.5	6.0	5.0	2.5—1.8 lime, 0.2 magnesia, 0.5 oxide of iron.	1. 0.5 alumina, 0.5 oxide of iron.	0.5	81.0	1.52
13	From near Dubuque river bottom, from a corn field -	3.6	3.0	4.0	2.5 lime, magnesia, and a little oxide of iron.	1. - - -	5.0	86.0	1.92
14	Average soil from townships 84, 85, 86, 87, range 3 west of the 5th principal meridian.	4.3	3.0	4.0	1.5 chiefly alumina -	0.5 oxide of iron -	2.0	85.0	2.08
15	Township 81 north, range 2 east of the 5th principal meridian.	1.5	3.0	1.5	1.0 chiefly lime - -	0.5 oxide of iron -	1.0	91.0	2.60
	Average of fifteen specimens - -	3.6	4.8	5.13	- - - -	- - - -	–	82.5	1.84

Note.—The acids in combination with the bases were muriatic, and a small per centage of sulphuric and carbonic. A minute examination would, perhaps, have detected phosphoric acid also; but the time allotted me for these analyses was too limited, and the quantity of soil operated on too small, to permit me to undertake these nice analytical details. Since, however, the virgin soils of Iowa and Wisconsin produce excellent crops of wheat, there is reason to believe that phosphates exist in them.

To a correct appreciation of the results obtained from the above table, it may be remarked, that the organic matter of the soil (sometimes called *geine*)—the food of plants—the substance which, by the action of air and water, has been prepared, or is in course of preparation, to enter into the circulation of the plant, is that portion of the soil which chiefly communicates to it its prolific qualities; and that, all other things being equal, a soil may be expected to be productive, in proportion to the amount of organic matter it contains.*

This organic matter is in part soluble, and in part insoluble, in alkali. The soluble portion of it is supposed, with much plausibility, to be that which is already prepared to become nutriment for plants; the insoluble portion is regarded as that which, by the action of air and moisture, and other influences, will hereafter become so.

If this theory be an accurate one, it follows that those soils which contain a large proportion of soluble organic matter will be fertile for the time; but that they must also contain a good supply of insoluble geine to preserve their fertility. And thus the column of soluble organic matter of the table is that which measures the *present productiveness*, and that of insoluble organic matter that which indicates the *durability* of the soil.

The salts which enter into the composition of a soil are considered by agricultural chemists as its stimulating ingredient. Chaptal, in his "Chemistry applied to Agriculture," says, (a little fancifully, perhaps,) "The salts are to plants, what spices and marine salts are to man."† It is certain that the salts in any soil exert upon the organic matter a chemical action, and contribute to regulate and facilitate the process of nutrition. Without an adequate supply of saline material, then, a soil lacks one of the essential ingredients of fecundity.

To form an estimate, from the above table, of the quality of the Wisconsin soils, it is necessary to compare its results with similar results obtained in countries in which, by actual culture, the value of the soil has to some extent been proved. The difficulty here is, that such analyses of soils have very rarely been made or recorded. Professor Hitchcock, in his report, of the year 1838, on the Economical Geology of Massachusetts, furnishes a valuable table of this kind, exhibiting the analyses of one hundred and twenty-five specimens, which, as he informs us, may be considered as about the average quality of the soils of that State. He adds: "As this is probably the first attempt that has been made to obtain the amount of *geine* in any considerable number of soils, we cannot compare the results with those obtained in other places. They will be convenient, however, for comparison with future analyses."

And they do accordingly furnish data for a comparison, both interesting and important, between the soil of Massachusetts and that of Wisconsin.

The following are the results obtained from Professor Hitchcock's table:

Average quantity of *soluble geine* (organic matter) -	3.90 per cent.
Average quantity of *insoluble geine* (organic matter) -	3.70 "
Average specific gravity of soil - - - -	2.44 "

My own table, as will have been remarked, shows the results for the soils of Iowa and Wisconsin to be—

* An exception to this rule, which should not be overlooked, exists in the case of bog or peat soils; which, however, possess in general but little *soluble* organic matter.

† Dr. Dana improves on this idea. He says: "The earths are the plates, the salts the seasoning, and the geine the food of plants."

Average quantity of soluble organic matter - - 4.80 per cent.
Average quantity of insoluble organic matter - - 5.13 "
Average specific gravity of soil - - - - 1.84 "

The first result which strikes the eye is the large amount of organic matter in the Iowa and Wisconsin soils, compared with those of Massachusetts—nearly *one-third* greater.

The second is the great specific gravity of the Massachusetts soils, compared with those of Iowa and Wisconsin—nearly *one-third* greater.

A more careful inspection shows that the amount of *organic matter is, almost to mathematical accuracy, in the inverse ratio of the specific gravity of the soils.*

It would be a hasty inference thence to deduce the conclusion that soils are rich in geine, in proportion to their specific lightness; yet the coincidence, in this respect, is marked and worthy of attention.

It will be seen, for instance, that specimen No. 6, the richest valley soil, containing the enormous quantity of *twenty-six* per cent. of organic matter, is considerably lighter than any other specimen, and is only about *one-half the weight* of the average soil of the entire State of Massachusetts; while the specimen No. 10, heavier than any single soil among the 125 examined by Professor Hitchcock, (specific gravity 2.82,) has but *one* per cent. of organic matter; much less than any other specimen in the table.

In Professor Hitchcock's table, specimen 120 is the lightest, having a specific gravity of 2.17. This soil gave nearly *thirteen* per cent. of geine, almost double the average of the entire table, while the two heaviest specimens in the whole number, Nos. 20 and 21, (specific gravity 2.72 and 2.71,) had *no geine whatever;* and these are the only two specimens out of the one hundred and twenty-five thus totally devoid of organic matter.

In addition to this, there is throughout Professor Hitchcock's table (as it will be perceived there is also in mine) a *general* coincidence between a small specific gravity and a large quantity of organic matter.

If further analysis of soils in various portions of this and other countries should exhibit similar results, it would appear that a simple trial of the specific gravity of a soil may, in a general way, furnish an approximating test of its fertility.

Be this as it may, the dark mould which prevails over a large proportion of Iowa and Wisconsin, so rich in geine, and of so small specific gravity, has proved itself, wherever the farmer has trusted to its certain returns, instead of attempting the more hazardous venture of the mine, an excellent and productive soil; especially adapted to the culture of every species of culinary vegetables and small grain, and producing, probably, as good Indian corn as the State of New York, or any other State of the same latitude.

It will be observed, from the table, that the power of absorption is generally in proportion to the amount of geine and the lightness of the soil.*

This is an important item to the cultivator. Lands possessing this power in a considerable degree readily absorb the dew in dry weather; and in wet weather do not suffer the superfluous rain to accumulate on the surface.

A striking feature in the character of the Iowa and Wisconsin soils, as the table shows, is the entire absence, in most of the specimens, of clay,

* "In general, the more finely the parts of a soil are divided, the better they absorb water."—*Chaptal.*

This applies particularly, as the sequel will show, to the soils in question.

and the large proportion of silex. This silex, however, does not commonly show itself here in its usual form—that of a quartzose sand. It appears as a fine, almost impalpable, siliceous powder, frequently occurring in concreted lumps that resemble clay ; and, indeed, it was often reported to me incorrectly as clay—an error ultimately detected by analysis.

This almost impalpable powder, the chief constituent and almost sole residuum of the Iowa and Wisconsin soils, is so highly comminuted, that, when examined under the microscope, for the most part, its atoms present no crystalline or even granular appearance.

This fine siliceous residuum, after being boiled with strong aqua regia, lost but 10 per cent., of which but five per cent. was alumina.

This absence of any material per centage of clay in the soils under consideration prevents the rolling lands from washing away ; and it imparts to the streams a crystal clearness, which even after heavy rains is hardly disturbed. The appearance of these transparent rivulets, flowing over a soil which when moistened by rain is often of an inky blackness, arrests, by its singularity, the eye of a stranger.

Whether the lack of clay in the Iowa and Wisconsin soils will render them less durable may be doubted. A coarse sandy soil, the open pores of which suffer the rain to percolate, carrying with it the nutritive geine from the surface, requires an admixture of clay before it can become rich and durable ; but the minute-grained siliceous powder of this district forms a species of soil entirely different from the above—one which, without any such admixture, retains moisture and geine in much perfection.

I believe it to be peculiarly adapted to the growth of the sugar beet, which flourishes best in a loose fertile mould, and which has of late become, in some European countries, an important article of commerce. It is estimated that the amount of beet sugar manufactured in France during the last year was 100,000,000 pounds, and in Prussia and Germany 30,000,000 pounds. In the western part of Michigan, in as northern a latitude, and in a climate similar to that of Wisconsin, 240,000 pounds are reported by the papers of that State (how accurately I know not) to have been manufactured during last season.

In concluding this brief notice of the soils of this district, which I regret that time does not permit me to extend, I may add, that I know of no country in the world, with similar mineral resources, which can lay claim to a soil as fertile and as well adapted to the essential purposes of agriculture.

ADDITIONAL STATISTICS.

(*July*, 1844.)

Some important additional statistical details regarding the copper, lead, and zinc mines of Wisconsin, will be found in the following extract from a valuable letter, written by Mr. Stephen Taylor, of Mineral Point, in 1842, in reply to some queries addressed by me to that gentleman, requesting statistical information relative to the recent discoveries in his neighborhood since 1840. These more than confirm my estimate of the growing importance of these mines:

"FOREST OF RICHLAND, NEAR MUSCODAY, WISCONSIN,
"*July* 30, 1842.

"DEAR SIR: Your highly esteemed favor of the 4th ultimo has been on hand some days. I delayed answering it for the purpose of personally examining a new copper discovery, near Mineral Point, that I might be able to give you a more accurate account of it. This I have had the gratification of doing; and, so far as I am competent to judge, I conceive it to be by far the most valuable copper mine yet discovered in the United States.

"The diggings are upon the west half of the northeast quarter of section five, township four, range three east of the fourth principal meridian. The lode has been traced and worked two hundred feet from the shaft where it was first discovered. In this shaft small particles of copper ore mixed with its gangue were found, and this at the depth of twelve feet from the surface. There are, at this time, five shafts sunk upon the 'range,' leaving intervals of fifty feet. These shafts, for the sake of wholesome ventilation, are connected by drifts with a horizontal opening. The course of the lode is nearly east and west. The grounds have a gentle inclination from west to east, so that, where the first shaft required an excavation of twelve feet to reach the bottom of the 'cap rock,' the second required fifteen, the third twenty, the fourth twenty-five, and the fifth about twenty-nine feet. The shafts are sunk in a crevice leading to the opening *under the cap rock*, in which opening the ore is only found. The depth of the opening averages seven feet, and it is in width between the wall rocks fifteen feet. The superincumbent soil and clay stratum seem to retain a regular thickness of six feet along the line of shafts; consequently, the cap rock must increase from a thickness of six feet at the first shaft to twenty-three feet, in the distance of two hundred feet.

"In excavating the ore, for the personal safety of the miner, as well as to secure the mine from 'caving in,' large pillars of earth are left. These pillars occupy about one-half of the space in the opening, and are supposed to contain as much ore as has been obtained from the excavated parts. The quantity of ore raised from this mine, up to the 12th instant, is two hundred thousand pounds; and, estimating the remaining pillars to contain the same quantity, these diggings, thus far, will have yielded four hundred thousand pounds of ore that will well compare with the richest copper ore yet discovered in this region. The ore is principally a sulphuret, coated with green carbonate, which generally yields by analysis from thirty-five to fifty per cent.

"From the favorable appearance of the grounds, having an even surface for the distance of half a mile eastward, and judging from other surface indications, there is a probability that this lode may continue much farther.

"The estimated quantity of merchantable copper ore taken from these diggings is about one-fourth the contents of the opening, leaving the gozzin out of the question, *i. e.*, the small particles of carbonate adhering to the clay, chert, and to the usual matrix of the ores of these mines. The ore varies, from pieces of an ounce weight to masses of one hundred and fifty pounds. Of these fine specimens the miners seem very tenacious; the moment they are raised to the surface, they are concealed beneath the pile of smaller ore.

"This lode is worked by Messrs. William Kendall & Co. The land is owned by Judge Irvin and others.

"Another discovery of copper ore has recently been made, which is also under the cap rock, on the same elevated ridge, four hundred yards southward from Mr. Kendall's diggings, respecting which I can say but little, as it has not yet been thoroughly proved. The same remark may apply to a new discovery upon the south part of section thirty-five, township six north, range three east of the fourth principal meridian, near Dodgeville.

"Nothing more has been done at the old copper diggings, since you were here, than cleaning the ore which lay upon the surface, from which Messrs. Alford & Thomas, at the New Baltimore furnace, smelted about five thousand pounds of pig copper; and from the *new discovery* forty thousand pounds of pig copper have been smelted by Messrs. Kendall & Preston, whose furnace may now be considered in successful operation. The whole of this metal was shipped to New York, where it commanded sixteen cents per pound.

"Hence you see that the copper business is fast rising in importance, and the day is not far distant when we may look upon the copper mines of Wisconsin as being capable of producing a sufficient quantity of metal to supply the consumption of the United States, notwithstanding the vague reports which have appeared respecting them.

"The lead mines have not been so productive for many years as they are at this time. The old diggings, in the vicinity of Mineral Point, which were in a great measure abandoned when you visited them, are yielding now liberally to the miner the treasure for his labor. This is the case with the old diggings generally throughout the mining region.

"New and extensive discoveries of lead ore have been made west of and near Sinsineway Mound, where a village has recently been laid off, and named 'Fairplay.' These mines have, for eighteen months past, sustained a population of over six hundred. Other productive lodes have also been recently discovered on sections six, seven, and eight, township one north, range one east of the fourth principal meridian; and west of the old Dodgeville diggings another valuable lode has been opened.

"The largest lode ever yet discovered at Blue river was recently 'struck,' upon section twenty-eight, township seven north, range one east of fourth principal meridian. At these diggings two miners may mine and raise to the surface three thousand pounds of 'mineral' (lead ore) with ease in twelve hours; this, at thirteen dollars per thousand, will be thirty-nine dollars per day. The lode is proved for at least a hundred thousand pounds of ore.

"It is rumored that a valuable discovery of lead has been made north of and near the Wisconsin river, in range five west. Of its value or extent I have not learned. I am inclined to believe that, if galena is found in that quarter, it will be confined to the 'lower magnesian limestone,' the same formation which at Prairie du Chien affords such an excellent building stone, and lies, as you are aware, under the sandstone. Should valuable discoveries of galena be made in this lower limestone, Wisconsin may well be considered 'the most productive lead region in the known world.'

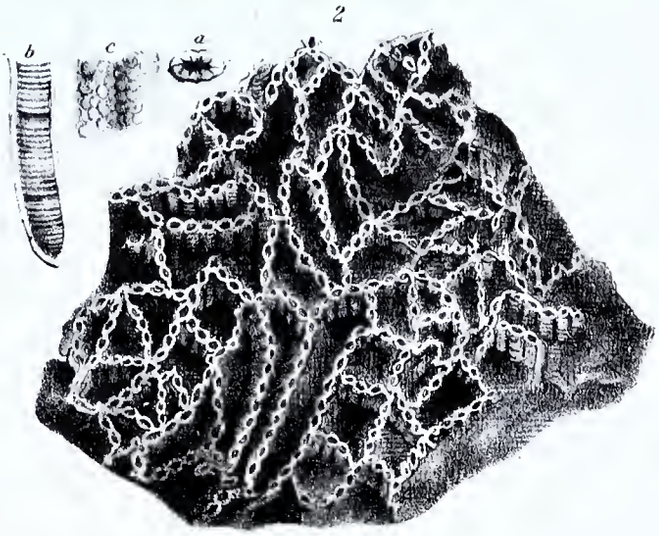
"*Zinc ore*, where it happens to be gangue of galena, is generally considered as *too productive*, and is held in detestation by miners, few of whom have any knowledge of the character or value of it. There are discoveries of this ore almost daily throughout the region. Should there be a demand for zinc ore, I feel convinced that Wisconsin can supply any reasonable quantity; in fact, I consider it quite as abundant in these mines as other ores.

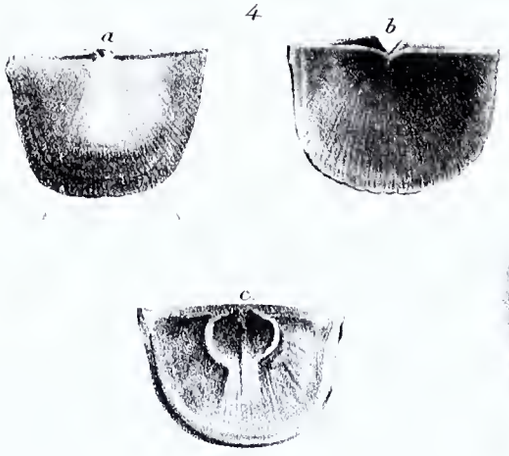
D D Owen del.

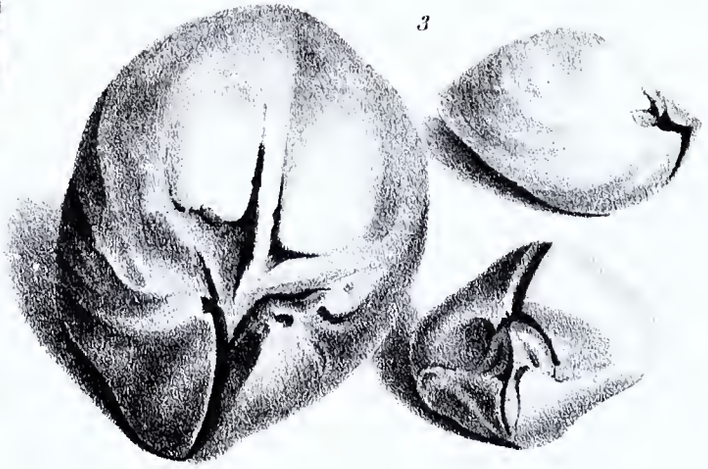
Lith. by E. Weber & Co Balt°

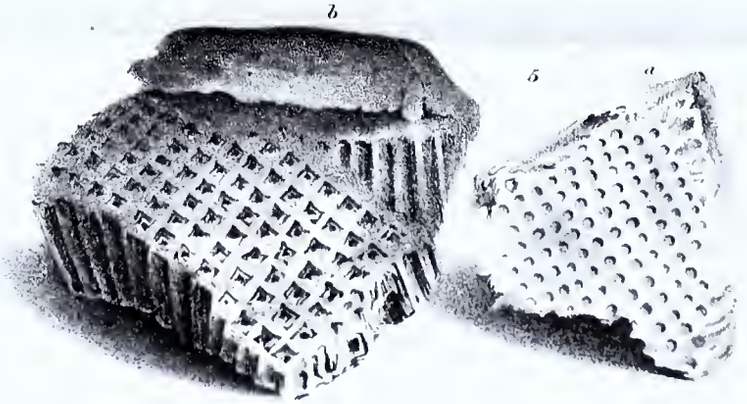
D. D Owen del.

Lith. by E Weber & Co. Balt.°









D. D. Owen del

P. Weber & co. Baltimore

"No steam engines which have been erected have met the expectations of the projectors. I understand, however, that there is one in progress of construction at Wiota (Hamilton diggings) which will probably be in operation this season. I look upon this matter as of vital importance in developing the mineral resources of this region. It would not only clear the mines of excess of water, but would enable miners to establish some better mode of raising to the surface the minerals and excavated earth than by the laborious use of the common windlass.

"I have frequently traversed the hills on both sides of the Wisconsin river, in search of minerals and fossils. I have never discovered any organic remains in the *sand rock* which forms part of the bluffs in the vicinity of the river.

"The blue fossiliferous limestone, which at Mineral Point is twelve feet in thickness, seems to disappear entirely before it reaches this part of the river bluffs, for at the outcrop of the 'cliff' or lead-bearing strata I can find no vestige of that rock."

DOCTOR LOCKE'S REPORT.

In the report made to me by Doctor Locke, and which is herewith forwarded, will be found a variety of interesting and useful matter.

As that gentleman, while acting as one of the geological corps of Ohio, had spent nearly an entire season in examining those counties in that State where the cliff formation is most marked and most readily studied, I intrusted to him the care of instituting a comparison between the corresponding formations in Ohio, and in Iowa and Wisconsin. This he has executed with his usual ability; and it will be found an important contribution to the geology of Wisconsin and of the West.

Of the practical importance of the barometrical observations of heights, whence the dip and thickness of the various strata are determined, I have already spoken in detail.

So, also, of the observations on the dip and intensity of the needle, as connected with the discovery of large masses of iron ore, especially of the protoxide. I may here add, that it was a matter of much interest, and one which has been fairly and fully tested in the course of the expedition, to decide whether lead, in the greatest masses, exerts any influence on the needle; and, as a consequent, whether that metal can be magnetically detected. It was well known that lead, in any ordinary mass, exerts no perceptible influence on the magnetic needle; but it remained to be proved whether, in the enormous quantity existing throughout the lead region of Wisconsin, it might not act upon instruments of a construction so peculiarly delicate as those employed by Dr. Locke. No appreciable influence, however, was exerted on the needle, even in the heart of one of the richest mines near Dubuque.

A portion of Dr. Locke's report, including the chapter on the earthwork antiquities of Wisconsin, however replete with interest to the scientific world, may be considered as touching upon topics which, according to the strict letter of my instructions, were not embraced therein. In justice to Doctor Locke, to myself, and to the department from which we obtained our commissions, I feel it my duty to state that these investigations into matters of mere curious research were made without adding a dollar to the cost to Government of this expedition. Even the magnetical observations on the variation of the needle, which have a practical

bearing, and cannot be considered supererogatory in the geological examination of a mineral region, were made, with few exceptions, either before the hour when the labors of the day commenced, or by candle light, when the other members of the expedition were wrapped in sleep; or during necessary intervals of rest, when awaiting the reports of a corps, or unavoidably delayed by any other circumstances. They were not suffered by Doctor Locke to interfere with the other duties intrusted to him, and which he performed as strictly and efficiently as if these had been his sole avocation. The antiquities were examined (to employ his own words) "by an enthusiasm which awoke him in his tent at midnight, and sent him into the bleak fields on a November morning, to finish the admeasurements of a whole group of figures before the usual time of commencing the labors of the day."

Thus Doctor Locke's contributions to abstract science and aboriginal history are tendered to the department and to the country, as a voluntary offering; which, if not demanded by official requirements, has not been paid for from the public purse.

To the assiduous industry and untiring perseverance of Doctor Locke, from the first day he joined the expedition until the hour of his final departure, exhausted in body and mind from his unremitted labors, no one can bear testimony more fully or more justly than myself.

REMARKS, IN CONCLUSION.

The deficiencies and imperfections which I am well aware that a critical examination will detect in the preceding report, should, in justice to all those concerned in the expedition, be viewed with reference to the extent of territory of which the survey was demanded, and the length of time permitted to complete it. An allotted task was to be performed in a given number of days. A district of country larger than the State of Vermont, and nearly equalling in area the State of Maryland, was to be geologically examined; the mineral appearances of each tract of land, its situation in the section, and its occupation by settlers, were to be specifically reported: all in two months and a few days. It will hardly excite surprise, if the further and important general requirement, to add "such facts as will convey some idea of its value and productiveness," should have been somewhat imperfectly performed.

The anxiety of the department to obtain in special reports, and without delay, certified assurance as to which tracts of land contained no lead or other valuable mineral deposites, so that such lands might be brought into market at the earliest day practicable, was strongly expressed; and the evident importance to the Government and to the settler that these special reports should be accurately made and speedily transmitted, designated them as the great official object of the exploration, to which all others, however important in themselves, or tempting from their scientific interest, ought of right to be postponed. Such general deductions, then, as are submitted in the present report, and such contributions to the geology of the West as its pages may furnish, were obtained but as incidental objects, upon which such time and attention only could be bestowed as were to spare after fulfilling the more immediate and special requisitions contained in my instructions.

And even when the expedition had closed its labors, and I retired to my laboratory to collect and arrange and examine a thousand materials,

which, in the hurry of a life in camp, I had hastily thrown together, and to submit to analytical test the various ores and minerals of the explored region, I did not consider myself at liberty to delay, until a late period of the session, the conclusion of my report, inasmuch as, by the wording of the resolution of Congress under which the survey was instituted, the information sought by this expedition is evidently intended to aid the President in "causing to be prepared, and presented to the next Congress, at an early day, a plan for the sale of the public mineral lands, having reference as well to the amount of revenue to be derived from them, and value as public property, as to the equitable claims of individuals." Thus, an exploration hastily made has been, from necessity, as hastily reported—a disadvantage which those who know the time demanded to obtain accuracy in chemical analysis, and to prepare suitable illustrations for a geological report, will duly appreciate.

On the other hand, I may remark, that much of what to some may seem abstract scientific research was necessary to enable me to make, with judgment and accuracy, even those formal and apparently mechanical reports, which were transmitted weekly to the respective land offices, and to the General Land Office at Washington city.

To search for and ascertain the value of the mineral resources of a country, without strictly examining and defining the character and succession of its geological formation, would be like putting to sea without a compass; and in determining that geological character, many things that seem trifles to the uninitiated (the examination of characteristic fossil remains, for example) are of prominent and essential importance.

I have endeavored, in the conduct of this expedition, and in the framing of the present report, to preserve a due medium between a latitudinarian construction of my official instructions, involving an expenditure of public funds for objects not contemplated in the original projection of the enterprise, on the one hand, and, on the other, a contracted and illiberal interpretation of the same, an adherence to the letter at expense of the spirit, which saves without economizing, and destroys the very object of such an expedition, by way of curtailing its indispensable expenses. How far I have succeeded in this endeavor, others must judge.

A collection of several thousand specimens, consisting almost entirely of ores, soils, ore-bearing rocks, and their distinctive fossils, was, at a trifling additional expense, collected and arranged, and now awaits the further instructions of the department. A descriptive catalogue of each variety (numbered from 1 to 136) has been made out, and is appended to this report. Each separate specimen in the whole collection has attached to it a printed label, specifying, according to my instructions, the "quarter section, township, and range, from whence the same was taken;" and likewise marked with a number, corresponding to the number on the descriptive catalogue, and also to the numbers on the township maps and the general map of the district. Thus, an inspection of these maps in connexion with the catalogue will show, at a glance, the character of rock and species of mineral at any given location; and will also exhibit the bearings and boundaries of the different formations throughout the district.

I trust that I shall not be considered as overstepping the sphere of my duty, if I suggest the importance, in an economical as well as scientific point of view, of having these specimens arranged in some suitable apartment at the seat of Government, as the nucleus of a national cabi-

net.* Not only the man of science, but the practical miner, would inspect such a collection with deep interest; and it might be the means at once of gratifying laudable curiosity and of stimulating commercial enterprise.

I doubt whether any other geological cabinet, public or private, has its specimens located with the same minute accuracy as, from the nature of this survey, I have been enabled to locate these; and it is accuracy of location which gives to all geological and mineralogical specimens their chief value.

A somewhat copious appendix to this report has been forwarded, intended chiefly as a table of reference. It contains a brief description of each separate township in Iowa and Wisconsin, (in number about two hundred and forty,) specifying the geological formation and mineralogical character of each; its organic remains, if any; its ores and minerals, if worthy of remark; the nature and quality of its soil; the proportion of prairie and timber; the species and quality of timber; how watered; the face of the country, whether level or hilly; and occasionally other remarkable particulars.

The separate township maps, which were transmitted to the department in January last, contain brief annotations, corresponding to the above information; the catalogue numbers of the specimens found in each; and the names and claims of the settlers on each tract, as far as these last could be accurately ascertained.

These elaborate details, exhibiting the materials whence my general deductions have been made, may supply an antidote, if such be required, to any hasty or over-sanguine opinions I may have expressed in regard to the value and importance of the territory which has been explored. It is difficult, when the attention has been strongly bent for a length of time upon any particular discovery, to avoid exaggerating, to some extent, its importance. The explorer is apt to become the special pleader. And it is not for me to say that I have avoided (though I have certainly endeavored to avoid) this error.

In concluding my report, I desire to express my grateful remembrance of the promptitude with which not only every Government officer to whom I had occasion to address myself, but also the principal inhabitants of the country, exerted themselves to forward the objects of the expedition. It would be invidious to select individual instances of hospitality and kindness, where these were of daily occurrence. The settlers, in general, were found willing to render assistance, and to communicate what information they possessed; and no instance of ill feeling or collision occurred between them and any individual employed on this expedition.

The members of the expedition generally, and my sub-agents in particular, discharged their duties, on the whole, with faithfulness and industry, and often with a degree of ability which gave me the highest satisfaction.

All which is respectfully submitted.

DAVID DALE OWEN,

Principal Agent to explore the Mineral Lands of the U. S.

Hon. JAMES WHITCOMB,

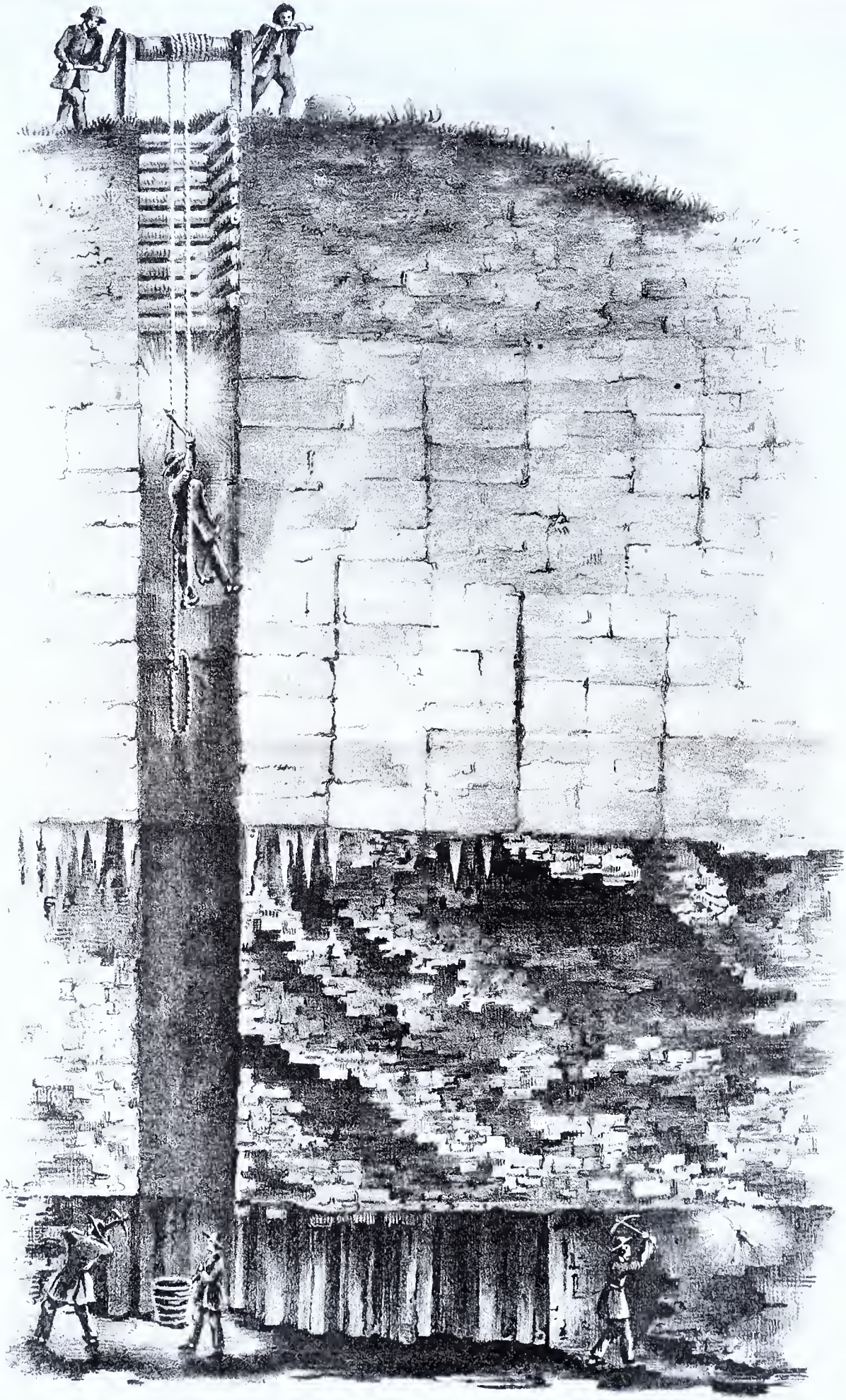
Commissioner of the General Land Office.

* Since this report was made, I received instructions from the department, in accordance with a request made by the Secretary of War, to forward the specimens above referred to to the seat of Government, that they might form part of a collection of public specimens of natural history, for the collection and preservation of which a law of Congress, bearing date July 20, 1840, contains an appropriation. The collection was forwarded accordingly, and is, I believe, now arranged in the new Patent Office.


PLATE Nº 4.
CHART
of the
GREAT ILLINOIS
COAL FIELD
Galena
Rock R.
Fox R.
Chicago
LAKE MICHIGAN
LAKE ERIE
Maumee R.
Peoria
Logansport
Lafayette
Attica
Covington
Quincy
Springfield
Jacksonville
Terrahaute
Indianapolis
Carrollton
Bloomington
Alton
Edwardsville
Vandalia
Salem
Mt Pleasant
Vincennes
St Charles
St Louis
Albion
Princeton
New Albany
Leavensworth
Louisville
Mt Vernon
Herculaneum
Frankford
Potosi
Brownville
Shawneetown
Hartford
Jackson
Cape Girardeau
Vienna
Smithland
Bowling Green
Hopkinsville
Russelville
Cumberland R
Tennessee R
Green R
IOWA
ILLINOIS
INDIANA
KENTUCKY
MISSOURI
COAL FIELD
MISSISSIPPI RIVER
MISSOURI RIVER
WABASH R.
Kaskaskia
OHIO RIVER
18 17 16 15 14 13 12 11 10 9 8 7 6
42 43 41 40 39 38 37

D D Owen del.

Lith by E Weber & Co



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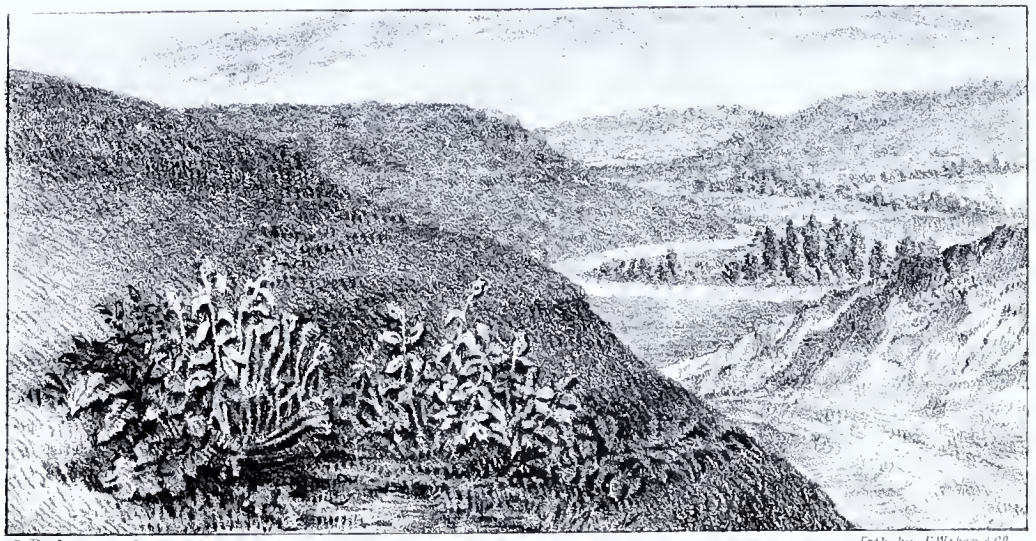

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APPENDIX.

Description of some organic remains figured in this work, supposed to be new.—By D. D. Owen.

Cyathopora *Iowensis*, (*see plate No.* 11, *after page* 72.)—Twig-like, single or branching; cellular. Cells diverging from the axis to the circumference, and opening on the surface in distinct cup-shaped mouths, with an elevated margin, one inch and a half long, one-seventh of an inch in diameter.

Orthoceras *undulatum*, (*see plate No.* 12, *figure No.* 6, *after page* 74.)—Long and tapering; oval; septal rings sharp, projecting, and slightly oblique and undulating.

Gyroceras *cornutes*, (*see plate No.* 12, *figure No.* 8, *after page* 74.)—Coiled at least once and a half; tapering gradually; flattened around the dorsal and probably the ventral margins. Septa plain, and slightly undulating; numerous. Greatest diameter of coil, three inches and six-tenths. Embedded in the rock, this fossil resembles an Ammonite.

Delthyris *euruteines*, (*see plate No.* 12, *figure No.* 9, *after page* 74.)—Cardinal area wide; strong mesial sulcation, somewhat wrinkled; ribs from thirteen to sixteen on each side of mesial sulcation; breadth one inch and three-eighths, length one inch.

Anthophyllum *expansum*, (*see plate No.* 13, *figure No.* 3, *after page* 76.)—Short; margin oval; thick, expanded, and slightly inclined; terminating cell cupped, and flat in the centre; lamellæ numerous, close, and sharp; weathered external surface rough; one inch and five-eighths high at the most elevated part. Greatest circumference one inch and three-quarters.

Lunulites? *daetioloides*, (*see plate No.* 13, *figure No.* 4, *after page* 76.)—Truncated spherical, with five or six sided cellular depressions in rows around the circumference, like those on a thimble, one inch and a quarter in circumference.

Cyathophyllum *ealiculare*, (*see plate No.* 13, *figure No.* 5, *after page* 76.)—Bell shaped; curved; margin inclined, thin, and nearly circular; deeply excavated; internal laminæ rather obscure; external weathered surface rough; one inch and a half long.

Cyathophyllum *corinthium*, (*see plate No.* 13, *figure No.* 6, *after page* 76.)—Conical, short, single; margin turned over like the leaves on the capital of a Corinthian column. Height one inch and an eighth; greatest diameter one inch and three-tenths.

Cyathophyllum *undulatum et multiplicatum*, (*see plate No.* 13, *figure No.* 10, *after page* 76.)—Long, cylindrical, and tortuous; very slightly tapering at lower extremity; strongly wrinkled by the projection of the margins of the prolifying cells; excavation shallow; internal lamellæ short and sharp; externally, between the margins of growth, nearly smooth, with obscure horizontal striæ. Length three inches and three-[illegible] diameter one inch and six-tenths.

SARCINULA (PORITES ?) *glabra*, (*see plate No.* 13, *figure No.* 11, *after page* 76.)—Resembles SARCINULA *costata* of Goldfuss, but tubes closer together, and not longitudinally ribbed.

LAMELLOPORA.—Composed of thin parallel laminæ, lying close together, and bound together layer upon layer.

LAMELLOPORA *infundibularia*, (*see plate No.* 14, *figure No.* 1, *after page* 78.)—Laminæ irregularly arched and undulating, forming funnel-shaped concentric connexions, not always immediately perpendicular one over the other; upper surface pitted; under surface with pimple-like elevations, pierced with a small hole.

ASTREA *mamillaris*, (*see plate No.* 14, *figure No.* 3, *after page* 78.)—Stars very much elevated, so as to form mamillary processes, irregular both as to size and distance apart; rays confluent.

ASTREA ? *gigas*, (*see plate No.* 14, *figure No.* 7, *after page* 78.)—Laminæ of growth very distinct; undulating, so as to form *large* stars; elevated and tucked in at the centre; confluent, unequally distant; rays distinct and prominent.

LINGULA *Iowensis*, (*see plate No.* 15, *figure No.* 1, *after page* 80.)—Resembles *L. lamellata* H., of the Niagara group, but is larger and straighter on the lateral edges. It differs from *L. rectilateris*, in being flatter, and not so pointed at the apex.

OTHOCERAS *marginale*, (*see plate No.* 16, *figure No.* 6, *after page* 82.)—Oval; septal lines elevated on the sides, in the direction of the long diameter; siphuncle large, (half an inch in diameter,) placed laterally in the line of the short diameter.

CYRTOCERAS *conicum*, (*see plate No.* 16, *figure No.* 9, *after page* 82.)—Oval, and slightly angular at the posterior margin; very short; septal lines few, (four or five in number;) curved from the posterior to anterior margin; resembles C. marginale, Con., but much shorter and more curved. Height at the most elevated part one inch and three-tenths; greatest diameter one inch.

STROPHOMENA *convexa*, (*see plate No.* 17, *figure No.* 2, *after page* 84.)—One valve very convex, other very concave, near the margin. Striæ fine; concentric lines of grow near the margin. Internal support diamond shaped, sometimes nearly circular. Length eight-tenths of an inch; breadth one inch and one-tenth.

ORBITULITES? *reticulata*, (*see plate No.* 18, *figure No.* 7, *after page* 86.)—Discoid; convex on the under side; slightly concave on the upper; structure concentric. Surface reticulated with diamond-shaped cellular depressions, in curved rows, radiating from the centre to the circumference, like the engine turning on a watchcase. This fossil resembles, somewhat, Murchison's ISCHADITES *konigü*, but this Iowa fossil is not globular, and I have not discovered any cicatrix for the insertion of a pedicle. It seems to agree in most of its generic characters with the description, in Goldfuss, of Lam., genus ORBITULITES.

[To face plate No. 11.]

FOSSILS OF THE CARBONIFEROUS LIMESTONE OF IOWA.

Figs. 1 and 2. Weather-worn slabs of carboniferous limestone, containing a variety of ENTROCHITES, RETEPORA, TENTACULITES; and a new coralline, CYATHOPORA *Iowensis*. O.

Figures the natural size.

WEATHER-WORN SLABS OF CARBONIFEROUS LIMESTONE OF IOWA

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D. D. Owen del.

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Figs

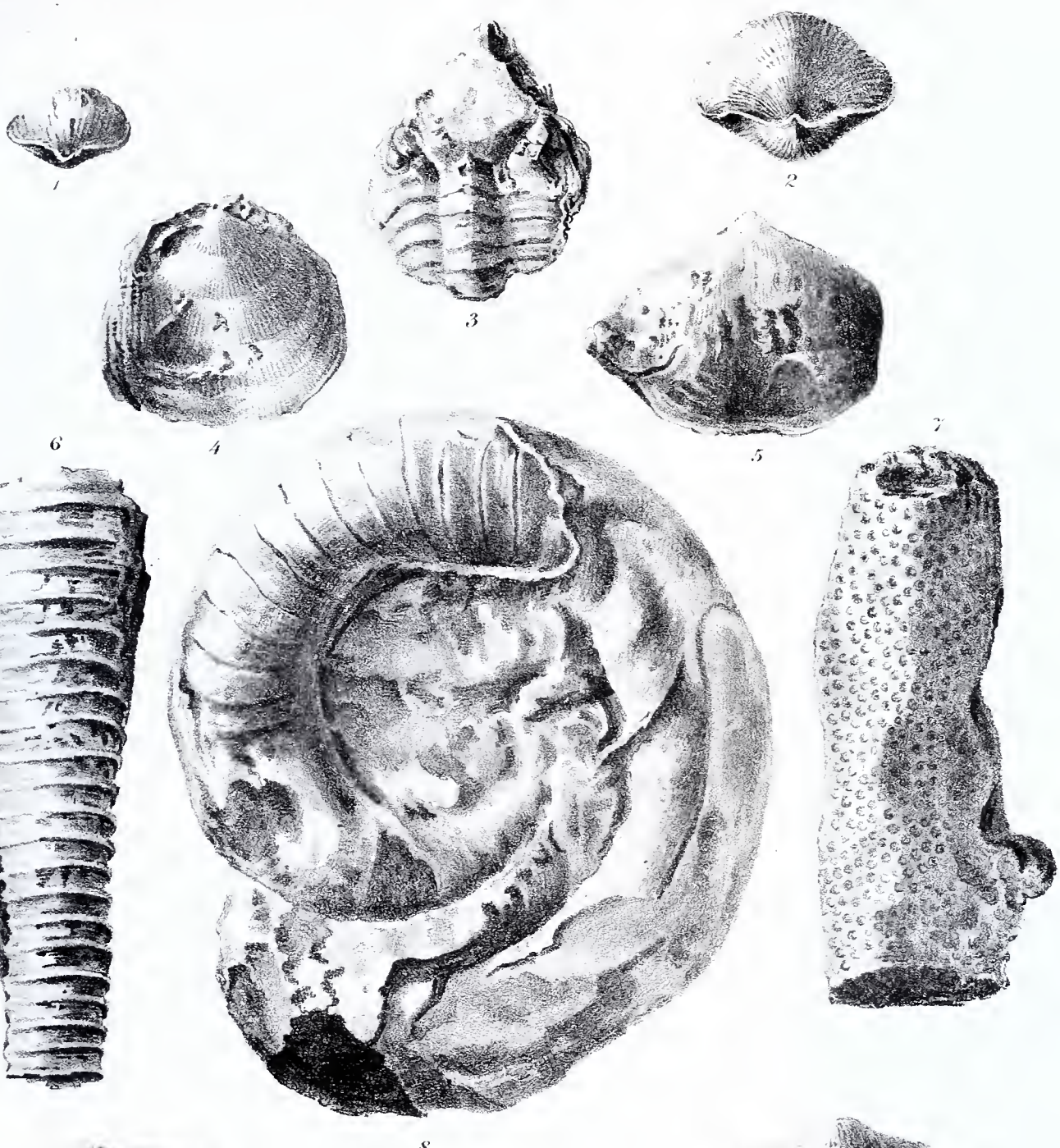
Figu

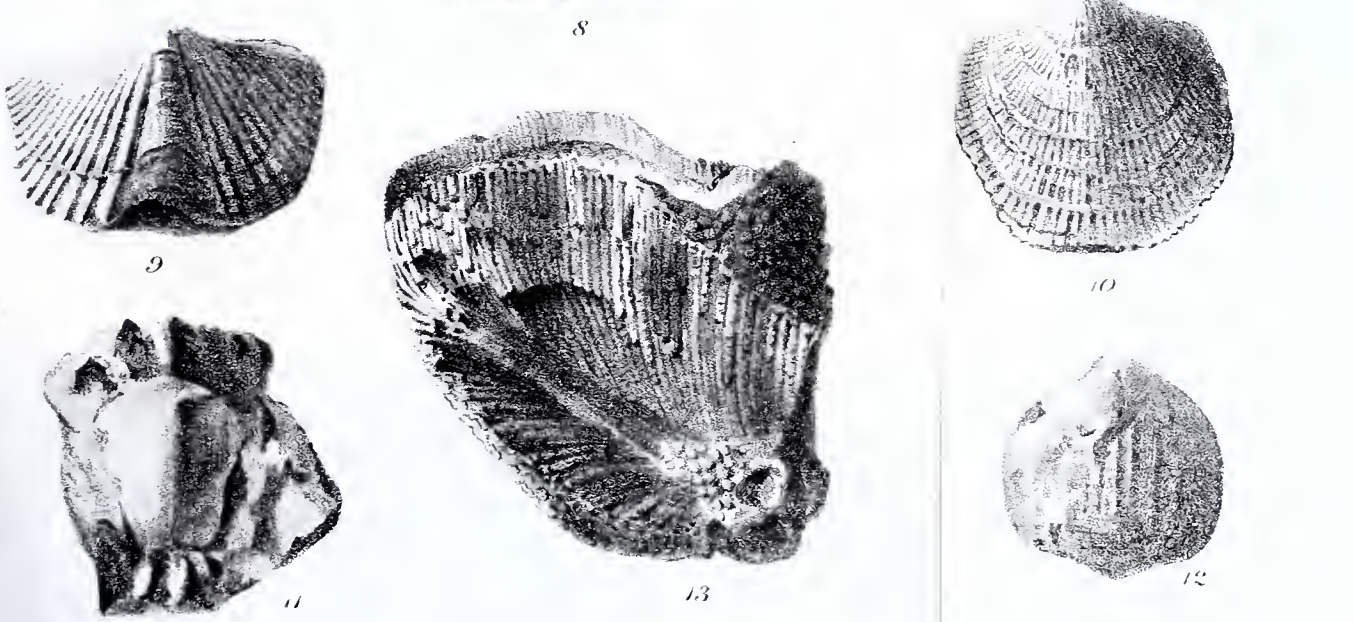
[To face plate No. 12.]

FOSSILS OF THE SHELL BEDS OR WHITE LIMESTONE OF RED CEDAR, WAPSINONOX, IOWA CITY, AND ROCK RIVER.

Fig. 1. Atrypa *limitaris*? Vanuxen.
Fig. 2. Atrypa *prisca*. Hingevien.
Fig. 3. Calymene *bufo*. Green.
Fig. 4. Atrypa.
Fig. 5. Delthyris.
Fig. 6. Orthoceras *undulatum*. O. Fragment.
Fig. 7. Favosites *polymorpha ramosa*. Goldfuss.
Fig. 8. Gyroceras *cornutis*. O.
Fig. 9. Delthyris (Spirifer) *euruteines*. O.
Fig. 10. Atrypa *prisca*.
Fig. 11. Bellerophon.
Fig. 12. Nucula?
Fig. 13. Favosites polymorpha. Goldfuss.
Figures the natural size.

FOSSILS OF THE WHITE LIMESTONE OF RED CEDAR, WOPSINONOX, IOWA CITY AND ROCK RIVER.





D. D. Owen del.

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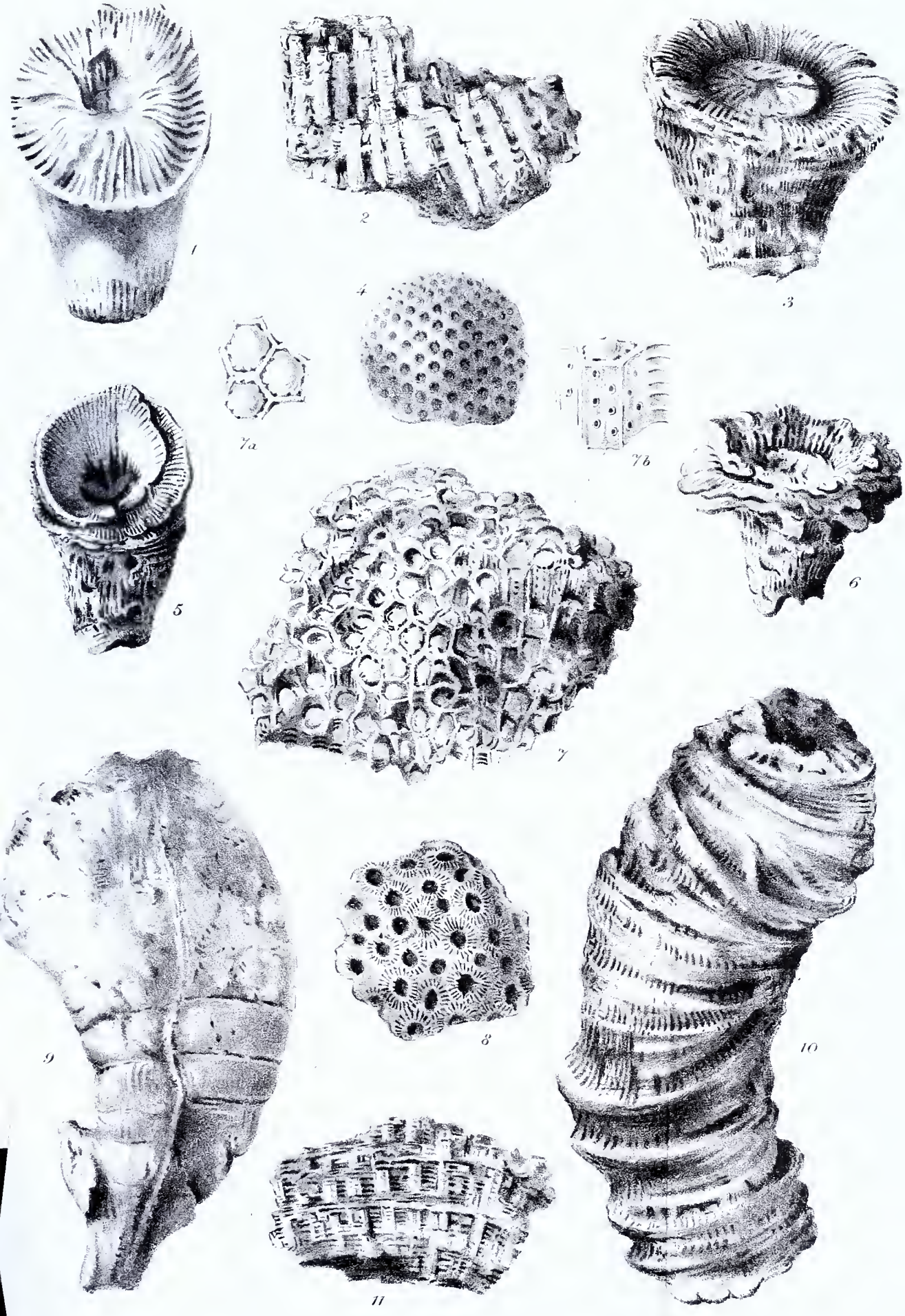
[To face plate No. 13.]

FOSSILS OF THE CORALLINE BEDS OF THE MAGNESIAN CLIFF LIMESTONE OF IOWA AND WISCONSIN.

Fig. 1. Cyathophyllum *helianthoides*. Goldfuss.
Fig. 2. Syringopora (*lineata?*)
Fig. 3. Anthophyllum *expansum*. O.
Fig. 4. Lunulites? *dactioloides*. O.
Fig. 5. Cyathophyllum *caliculare*. O.
Fig. 6. Cyathophyllum *corinthium*. O.
Fig. 7. Favosites *maxima?* Troost.
Fig. 8. Porites? *astraformis*. O.
Fig. 9. Phragmoceras *ventricosum?*
Fig. 10. Cyathophyllum *undulatum et multiplicatum*. O.
Fig. 11. Sarcinula (*porites?*) *glabra*. O.
Figures the natural size.

FOSSILS OF THE CORALLINE BEDS OF THE UPPER MAGNESIAN CLIFF LIMESTONE OF IOWA AND WISCONSIN.



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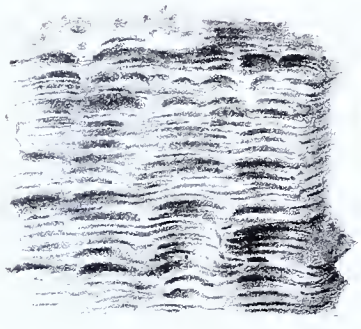
Lith. by E. Weber & Co. Balt.

[To face plate No. 14.]

FOSSILS OF THE CORALLINE BEDS OF THE MAGNESIAN CLIFF LIMESTONE OF IOWA AND WISCONSIN.

Fig. 1. Lamellopora *infundibularia*. O.
Fig. 2. Aulopora *serpens*. Goldfuss.
Fig. 3. Astrea *mamillaris*. O.
Fig. 4. Syphonia *piriformis?* Goldfuss.
Fig. 5. Nucula *minuta*. O.
Fig. 6. Cyathophyllum *turbinatum?* Goldfuss.
Fig. 7. Astrea? *gigas*. O.
Fig. 8. Cyathophyllum *vesiculosum?* Goldfuss.
Fig. 9. Orthis.
Fig. 10. Pentamerus *oblongus?*
Fig. 11. Astrea *fungiformis*.
Fig. 12. Sarcinula *costata*. Goldfuss.
Fig. 13. Tubipora *lamellosa*. O.
Figures the natural size.

FOSSILS OF THE CORALLINE BEDS OF THE UPPER MAGNESIAN "CLIFF"-LIMESTONE OF IOWA AND WISCONSIN.



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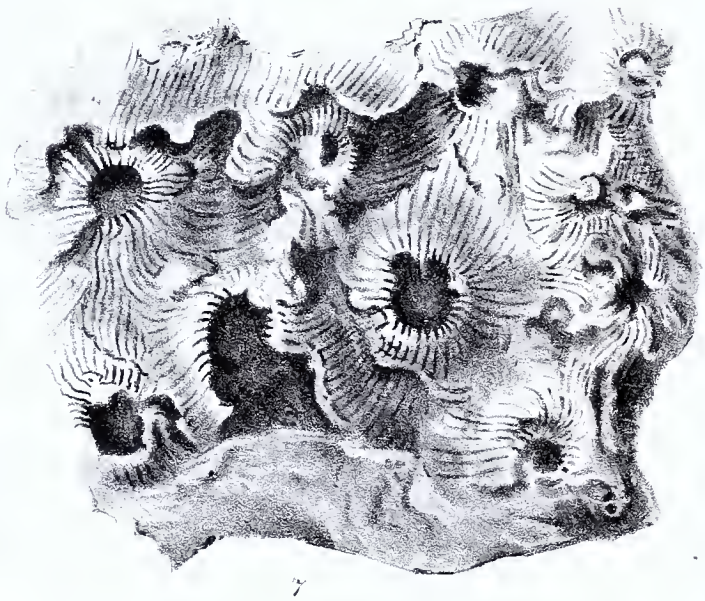

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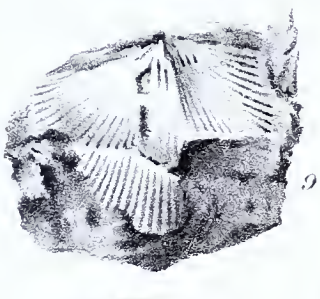

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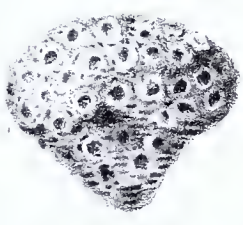

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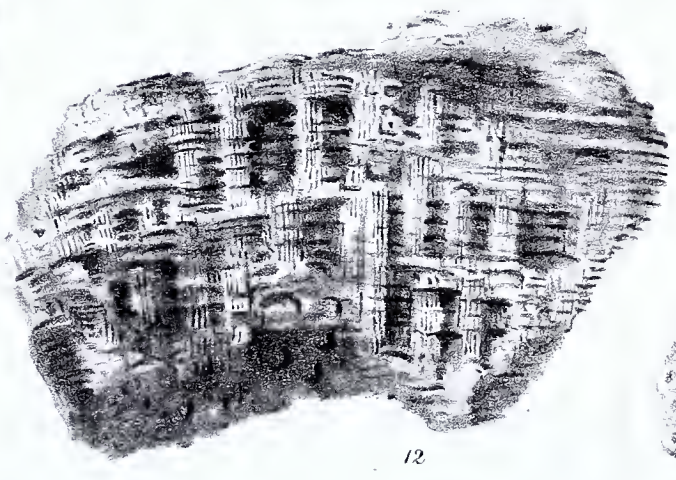

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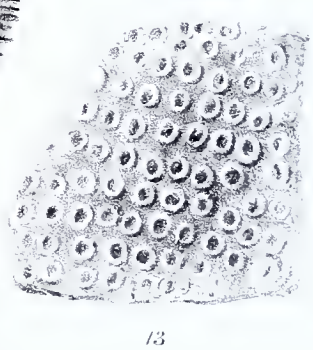

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[To face plate No 15]

FOSSILS OF THE LEAD-BEARING BEDS OF THE MAGNESIAN LIMESTONE OF IOWA.

Fig. 1. Lingula *Iowensis.*
Fig. 2. Bellerophon. Cast.
Fig. 3. Orthis. Cast.
Fig. 4. Pleurotomaria ? Cast.
Fig. 5. Trochus *lenticularis ?* Cast.
Fig. 6. Pleurotomaria. Cast.
Fig. 7. Delthyris. Cast.
Fig. 8. Euomphalus. Cast.
Fig. 9. Atrypa *orbicularis.* Cast.
Fig. 10. Pleurotomaria. Cast.
Fig. 11. Orthis *testudinaria ?* Cast.
Fig. 12. Bellerophon. Cast.
Figures the natural size.

FOSSILS OF THE LEAD-BEARING BEDS OF IOWA.


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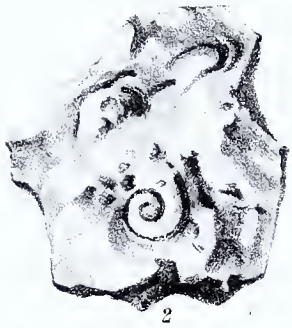
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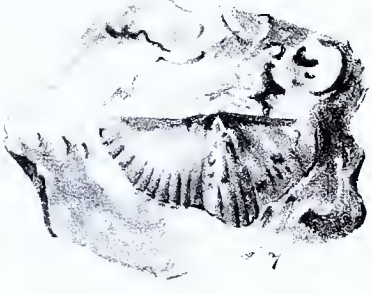
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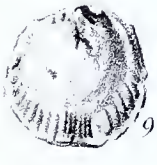
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[To face plate No. 16.]

FOSSILS OF THE LOWER LEAD-BEARING BEDS OF THE UPPER MAGNESIAN LIMESTONE OF WISCONSIN.

Fig. 1. Illænus. *Trentonensis?*
Fig. 2. Casts of Strophomena.
Fig. 4. Casts of Strophomena, Orthis? and Atrypa.
Fig. 5. Cyathophyllum *profundum.* Con.
Fig. 6. Orthoceras *marginale.* O.
Fig. 7. Pleurotomaria?
Fig. 8. Siliceous casts of Strophomena *deltoidea.*
Fig. 9. Cyrtoceras *conicune.* O.
Figures the natural size

FOSSILS OF THE LOWER LEAD-BEARING BEDS OF THE UPPER MAGNESIAN LIMESTONE OF WISCONSIN


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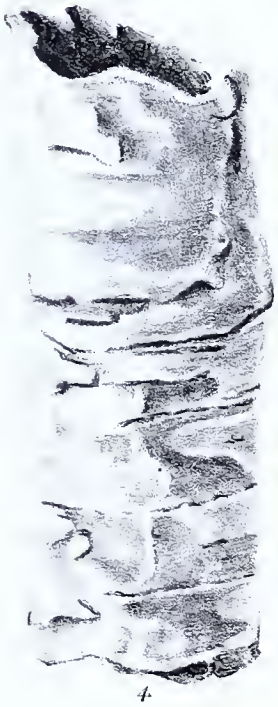
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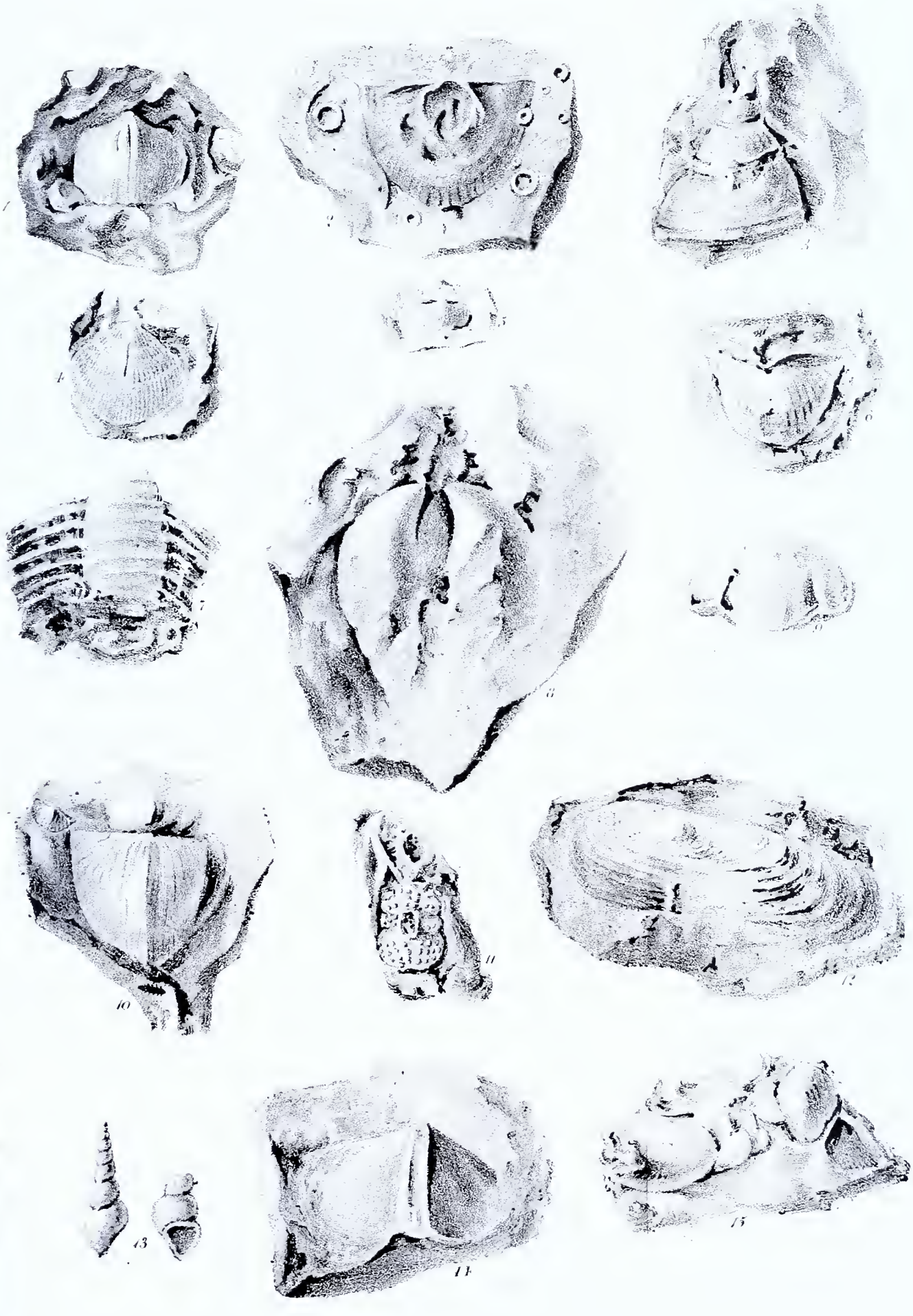
E. Weber & Co. Baltimore

[To face plate No. 17.]

FOSSILS OF SUBSTRATA OF BLUE AND GRAY LIMESTONE OF IOWA AND WISCONSIN.

Fig. 1. Orthis.
Fig. 2. Strophomena *convexa.* O. Internal view of concave valve.
Fig. 3. Pleurotomaria?
Fig. 4. Atrypa.
Fig. 5. Strophomena *sericea?*
Fig. 6. Strophomena *deltoidea.*
Fig. 7. Paradoxides?
Fig. 8. Cardium *Iowensis.* O.
Fig. 9. Thaleops?
Fig. 10. Strophomena *nasuta?*
Fig. 11. Ceraurus.
Fig. 12. Cypricardites.
Fig. 13. Pleurotomaria.
Fig. 14. Delthyris *expansus.*
Fig. 15. Bellerophon *bilobatus.*
Figures the natural size.

FOSSILS OF THE SUBSTRATUM OF BLUE AND GREY LIMESTONE OF IOWA AND WISCONSIN.



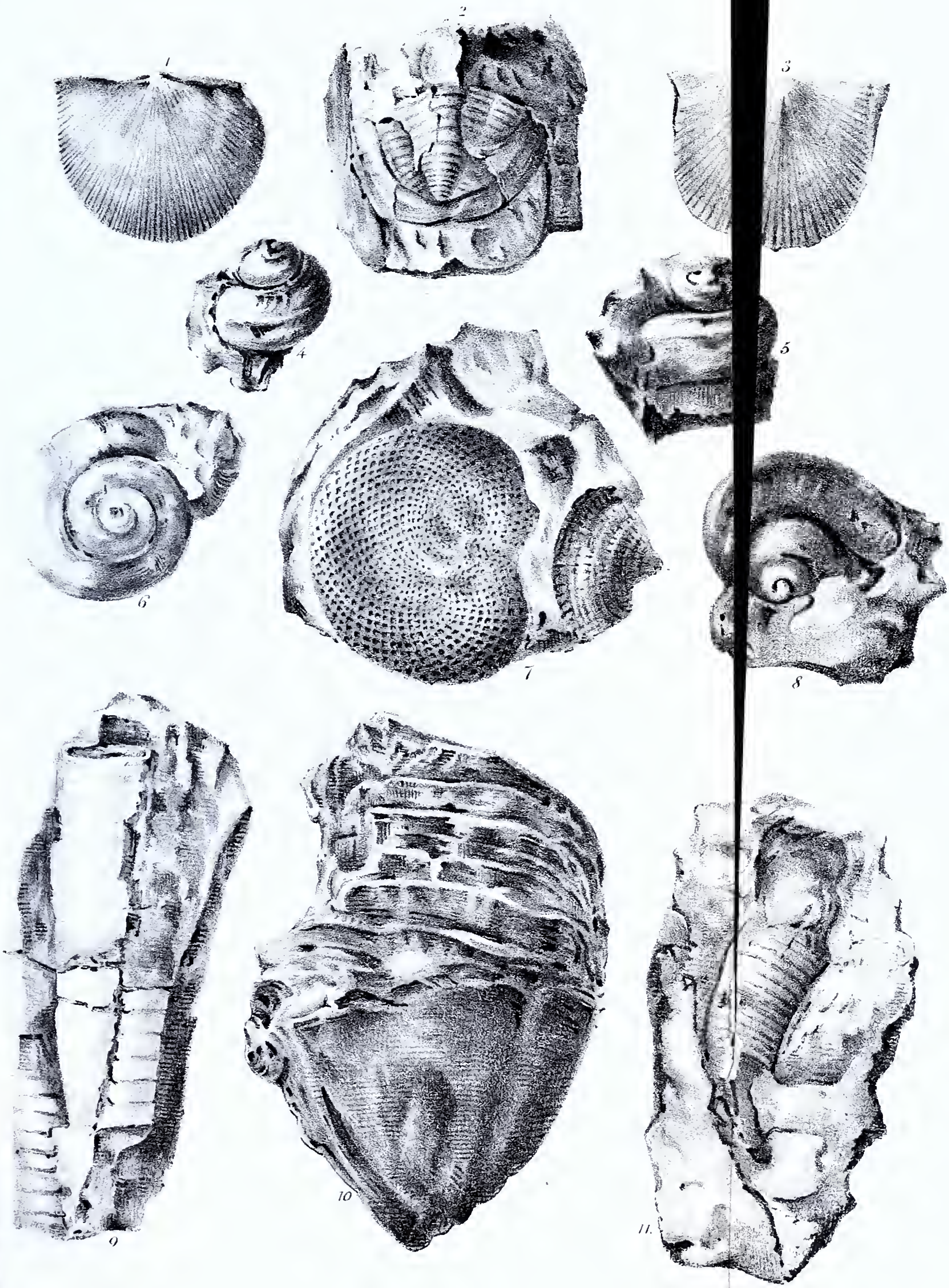
[To face plate No. 18.]

FOSSILS OF THE SUBSTRATA OF BLUE AND GRAY LIMESTONE OF IOWA AND WISCONSIN.

Fig. 1. Strophomena.
Fig. 2. Asaphus.
Fig. 3. Strophomena *angulata?*
Fig. 4. Pleurotomaria?
Fig. 5. Pleurotomaria *angulata?*
Fig. 6. Pleurotomaria *lenticularis.*
Fig. 7. Orbitulites? *reticulata.* O.
Fig. 8. Trochus?
Fig. 9. Orthoceras.
Fig. 11. Phragmoceras?
Figures the natural size.

Pl. XVIII

FOSSILS OF THE SUBSTRATUM OF BLUE AND GREY LIMESTONE OF IOWA AND WISCONSIN.



D. D. Owen del.

Lith. by E. Weber & Co.

No. III.

List of the principal localities of metallic ores.

LEAD ORE IN IOWA.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Southeast	35 and 36	91	1 west	5th	
Northwest	11	91	2 west	5th	Gay & Company's diggings.
Northwest	7	92	2 west	5th	New discovery.
Southwest	31	92	2 west	5th	
Northeast	3	89	1 east	5th	
North half	1	89	1 east	5th	
Southeast	1	89	1 east	5th	
West half	12	89	1 east	5th	
South half	11	89	1 east	5th	Gatten's diggings.
Northwest	2	89	1 east	5th	Shay's diggings.
Southeast	15	90	1 east	5th	Sherald's diggings.
Northeast	22	90	1 east	5th	Do.
Southeast	29	90	1 east	5th	
Northeast	32	90	1 east	5th	Timber diggings.
Southwest	33	90	1 east	5th	Do.
Southeast	34	90	1 east	5th	Durango diggings.
South half	35	90	1 east	5th	Do.
South half	36	90	1 east	5th	Do.
Northwest	36	90	1 east	5th	Do.
East half	2	88	2 east	5th	Catfish diggings.
Nearly all of	-	89	2 east	5th	Dubuque diggings.
Southwest	31	90	2 east	5th	Little Mekoqueta diggings.
Southeast	15	88	3 east	5th	Catfish diggings.
Southeast	27	88	3 east	5th	Do.
Northwest	22	88	3 east	5th	Do.
Southwest	26	88	3 east	5th	Do.
Northwest	23	88	3 east	5th	Do.
South half	9	88	3 east	5th	Do.
Northwest	18	89	3 east	5th	New discovery.
North half	4	87	4 east	5th	Tête des Morts diggings.
Southeast	5	87	4 east	5th	Do.
Northwest	5	87	4 east	5th	Do.
Near the line of	25 and 35	87	4 east	5th	New discovery.

LEAD ORE IN WISCONSIN.

South half	12	1	1 west	4th	Comstock's diggings.
All of	8, 9, 10	1	1 west	4th	Menomonie diggings.
South half	10	2	1 west	4th	Pateh diggings.
North half	9	3	1 west	4th	Do.
On almost every section of		3	1 west	4th	Platteville diggings.
North half	14	4	1 west	4th	
North half	15	4	1 west	4th	
Northeast	2	4	1 west	4th	
East half	18	4	1 west	4th	
West half	17	4	1 west	4th	
	14, 15, 26, 27				
	34, 35, & 36	5	1 west	4th	
South half	24	6	1 west	4th	Parish diggings.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Northeast	25	6	1 west	4th	Parish diggings.
Northwest	36	6	1 west	4th	Do.
Northwest	12	1	2 west	4th	Kilborn diggings.
Southeast	2	1	2 west	4th	
Southeast	35	2	2 west	4th	Menomonie diggings.
South half	36	2	2 west	4th	Do.
Northwest	28	2	2 west	4th	
Southwest	32	3	2 west	4th	
Southwest	17	3	2 west	4th	
Northwest	12	3	2 west	4th	
Southwest	31	3	2 west	4th	New discovery.
North half	33	4	2 west	4th	
Northeast	32	4	2 west	4th	
Northeast	28	4	2 west	4th	
South half	22	6	2 west	4th	
Northwest	1	2	3 west	4th	Travers's diggings.
North half	2	2	3 west	4th	Do.
	34, 35, 36, 27, 23, 24	3	3 west	4th	Snake Hollow diggings.
West half	20	4	3 west	4th	Pigeon diggings.
Northwest	20	3	4 west	4th	New discovery.
Southeast	15	4	4 west	4th	Day's diggings.
Northwest	15	4	4 west	4th	
Northwest	17	4	4 west	4th	McDonald's diggings.
South half	20	4	4 west	4th	Arthur's diggings.
	28, 29	4	4 west	4th	Beetown diggings.
Northeast	22	4	4 west	4th	New discovery.
Northeast	13	4	4 west	4th	Do.
South half	20	3	5 west	4th	
Northwest	20	3	5 west	4th	
Southwest	29	4	5 west	4th	Rattlesnake diggings.
Southwest	14	5	5 west	4th	
Mineral on almost every section in this township.	25, 26, 27	1	1 east	4th	New diggings.
	19, 30	1	1 east	4th	Hardscrabble diggings.
	29, 30	1	1 east	4th	Bull Branch diggings.
	31, 32	1	1 east	4th	Do.
	17, 21, 28	1	1 east	4th	Raccoon Branch diggings.
Northeast	31	1	1 east	4th	New discovery.
Northwest	35	2	1 east	4th	
Northeast	33	2	1 east	4th	
Northeast	32	2	1 east	4th	
Southeast	20	3	1 east	4th	Phillips's diggings.
Southeast	29	3	1 east	4th	Dunn's diggings.
Southeast	34	3	1 east	4th	D. Sailey's diggings.
Southwest	35	3	1 east	4th	Do.
	17, 18	4	1 east	4th	
South half	21	4	1 east	4th	Old diggings.
Southeast	20	4	1 east	4th	Do.
All of	3	5	1 east	4th	Peccatonnica diggings.
Northeast	9	5	1 east	4th	Do.
Southwest	8	5	1 east	4th	Do.
Southwest	18	5	1 east	4th	Do.
Southeast	14	5	1 east	4th	Do.
Southwest	13	5	1 east	4th	Do.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Southeast	20	5	1 east	4th	Peccatonnica diggings.
Northeast	30	5	1 east	4th	Do.
Southeast	22	5	1 east	4th	Do.
Northwest	25	5	1 east	4th	Do.
Northwest	31	5	1 east	4th	Do.
Southeast	31	5	1 east	4th	Do.
Northeast	34	5	1 east	4th	Do.
Southeast	35	5	1 east	4th	Do.
Southeast	36	5	1 east	4th	Do.
	5, 6, 7, 8	6	1 east	4th	Centreville diggings.
Southwest	4	6	1 east	4th	Do.
South half	3	6	1 east	4th	
Northeast	30	6	1 east	4th	Parish diggings.
Northwest	29	6	1 east	4th	Do.
Southwest	34	7	1 east	4th	Blue river diggings.
All of	28, 29	7	1 east	4th	Do.
Northeast	21	7	1 east	4th	Do.
Southeast	32	1	2 east	4th	White-oak Spring diggings.
Southwest	33	1	2 east	4th	Do.
Northwest	30	1	2 east	4th	New diggings.
Northwest	1	1	2 east	4th	Shellsburg diggings.
Northeast	2	1	2 east	4th	Do.
Southwest	2	1	2 east	4th	Do.
Northeast	11	1	2 east	4th	Do.
Southwest	11	1	2 east	4th	Do.
West half	10	1	2 east	4th	Do.
Southeast	10	1	2 east	4th	Do.
Northeast	36	2	2 east	4th	Stump Grove diggings.
Southeast	16	4	2 east	4th	
All of	8	5	2 east	4th	Pedlar's creek diggings.
East half	7	5	2 east	4th	Do.
Northeast	6	5	2 east	4th	Do.
Southwest	5	5	2 east	4th	Do.
Southeast	4	5	2 east	4th	Do.
Northeast	9	5	2 east	4th	Do.
Northwest	17	5	2 east	4th	Do.
Northeast	16	5	2 east	4th	Do.
Northwest	31	5	2 east	4th	Do.
Southwest	26	5	2 east	4th	Do.
East half	25	5	2 east	4th	Do.
East half	36	5	2 east	4th	Do.
	21	6	2 east	4th	
North half	29	6	2 east	4th	
Northeast	33	6	2 east	4th	
Northeast	34	6	2 east	4th	
Northwest	6	1	3 east	4th	Stump Grove diggings.
Northwest	28	1	3 east	4th	New discovery.
Northwest	31	2	3 east	4th	Stump Grove diggings.
Southeast	33	4	3 east	4th	Mineral Point diggings.
Northeast	25	4	3 east	4th	Do.
	5, 6, 16	4	3 east	4th	Do.
	7, 8, 17	4	3 east	4th	Do.
Northeast	20	4	3 east	4th	Do.
	29, 30	5	3 east	4th	Do.
	31, 32	5	3 east	4th	Do.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
South half	7	5	3 east	4th	
East half	6	5	3 east	4th	
West half	5	5	3 east	4th	
Southeast	5	5	3 east	4th	
	27, 28, 29	6	3 east	4th	Dodgeville diggings.
North half	33	6	3 east	4th	Do.
North half	34	6	3 east	4th	Do.
Southeast	21	6	3 east	4th	Do.
Southwest	22	6	3 east	4th	Do.
Northeast	17	6	3 east	4th	
East half	24	6	3 east	4th	
Northwest	12	2	4 east	4th	Whiteside's diggings.
Northeast	10	2	4 east	4th	Hamilton's diggings.
Northwest	11	2	4 east	4th	Do.
South half	13	2	4 east	4th	Do.
North half	24	2	4 east	4th	Do.
Northeast	12	2	4 east	4th	New discovery.
Southeast	17	3	4 east	4th	
Northeast	23	4	4 east	4th	
Northwest	20	4	4 east	4th	
Northeast	19	4	4 east	4th	
Northwest	31	4	4 east	4th	
Northwest	15	6	4 east	4th	New discovery.
Northwest	5	6	4 east	4th	Do.
Northwest	27	6	4 east	4th	Do.
Northwest	11	6	4 east	4th	
All of	22	6	4 east	4th	Brush diggings.
East half	21	6	4 east	4th	Do.
Northeast	28	6	4 east	4th	Do.
Southwest	19	6	4 east	4th	
Southeast	30	6	4 east	4th	
Southwest	29	6	4 east	4th	
North half	32	6	4 east	4th	
Northwest	33	6	4 east	4th	Renshaw diggings.
Southwest	8	1	5 east	4th	New discovery.
Northwest	19	2	5 east	4th	Hamilton's diggings.
Southwest	18	2	5 east	4th	Do.
Northwest	28	3	5 east	4th	
Northeast	4	3	5 east	4th	
Southeast	30	3	5 east	4th	
	28	4	5 east	4th	Fretwell's diggings.
East half	29	4	5 east	4th	
Northeast	30	4	5 east	4th	
Southeast	19	4	5 east	4th	
Northwest	20	4	5 east	4th	
	14	6	5 east	4th	Brigham's diggings.
	7, 8, 18	6	5 east	4th	
East half	19	6	5 east	4th	
South half	17	6	5 east	4th	
Northeast	25	6	5 east	4th	
Northeast	8	6	6 east	4th	Bigg's diggings.
Southeast	7	6	6 east	4th	
Southwest	8	6	6 east	4th	Blue Mound diggings.
Northwest	17	6	6 east	4th	Do.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Southeast	18	6	6 east	4th	Blue Mound diggings.
Northwest	30	6	6 east	4th	Do.
Southeast	27	6	6 east	4th	Shaw's diggings.
Southwest	26	6	6 east	4th	Do.
Southeast	16	6	6 east	4th	New discovery.
North half	3	2	7 east	4th	Skinner's diggings.
Northeast	10	2	7 east	4th	Do.
Northwest	11	2	7 east	4th	Do.
	On 28	2	7 east	4th	New discovery.
Southwest	35	2	7 east	4th	Do.
Southwest	13	2	7 east	4th	
South half	34	3	7 east	4th	Skinner's diggings.
Southwest	26	4	8 east	4th	Sugar creek diggings.
North half	34	4	8 east	4th	Do.
West half	27	4	8 east	4th	Do.
Northeast	35	4	8 east	4th	Do.
Southwest	21	4	8 east	4th	Do.

Note.—Gravel mineral was also found on the following localities, but, for reasons given in the body of the report, are not likely to be of importance.

	16 & 29	7	3 east	4th	New discovery.
	28	1	7 east	4th	Do.
	21	1	8 east	4th	Do.
	7	7	8 east	4th	Do.

LEAD ORE IN ILLINOIS.

		28	1 west	4th	
		29	2 west	4th	
		29	1 east	4th	Council or Vinegar hill diggings.
		28	1 east	4th	Buck's lode.
		27	1 east	4th	
	Northwest of	29	3 east	4th	White-oak Spring diggings.
	24 & 25	27	2 east	4th	Apple river diggings.
Near line of	32 & 34	29	4 east	4th	
		27	4 east	4th	
	Southeast of	28	2 east	4th	
		28	4 east	4th	

COPPER ORE IN WISCONSIN.

Northwest of	2 & 3	1	1 east	4th	
Southwest	21	1	1 east	4th	
Northwest	8	6	1 east	4th	Some small pieces found.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Northeast	5	4	3 east	4th	Ansley's copper diggings.
Northwest	32	5	3 east	4th	
Southeast	32	5	3 east	4th	
Southeast	31	6	4 east	4th	
Southeast	33	6	4 east	4th	
Northeast	4	2	5 east	4th	

ZINC ORE IN IOWA.

Southwest	31	90	2 east	5th	At Ewing's diggings.
Southeast	15	90	1 east	5th	At Sherald's diggings.

ZINC ORE IN WISCONSIN.

Southwest	30	3	1 west	4th	
Southwest	21	1	1 east	4th	
Northwest	8	6	1 east	4th	
Northwest	28	7	1 east	4th	
Northeast	9	5	2 east	4th	
Southeast	8	5	2 east	4th	
		5	3 east	4th	At many of the diggings.
Northeast	33	6	4 east	4th	

IRON ORE IN IOWA.

Between	15 and 16	85	1 east	5th	A little discovered.
Southeast	11	87	1 east	5th	Good specimens found, but no great quantity discovered.
Southeast	35	87	1 east	5th	Do.
	13	88	1 east	5th	
Southeast	8	90	1 east	5th	Some small fragments.
Northeast	36	84	2 east	5th	Beautiful pipe ore.
Northeast	28	84	2 east	5th	Found in loose fragments.
Northeast	23	84	2 east	5th	Do.
Southwest	12	84	3 east	5th	Do.
Northeast	3	84	3 east	5th	Do.
North half	1	84	3 east	5th	Do.
East half	4	84	3 east	5th	Do.
Southeast	30	84	3 east	5th	Do.
Northeast	2	84	3 east	5th	Do.
	10, 11	85	3 east	5th	In loose masses found, one of which weighed 20 pounds.
	12, 33	85	3 east	5th	Do.
	34, 35	85	3 east	5th	Do.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
Southwest	5	85	3 east	5th	In loose masses found, one of which weighed 20 pounds.
Northwest	17	85	3 east	5th	Do.
	24, 25	86	3 east	5th	Do.
	26, 35, 36	86	3 east	5th	Do.
Southwest	34	87	3 east	5th	Some good specimens found.
Northwest	7	88	3 east	5th	In numerous fragments.
Southwest	17	88	3 east	5th	Do.
		84	4 east	5th	In loose pieces, and in crevices of rocks.
		85	4 east	5th	Some small fragments.
Southwest	29	86	4 east	5th	Some fragments found, weighing about 15 pounds.
Southeast	32	86	4 east	5th	Do.
	25, 26	87	4 east	5th	In numerous fragments.
Northwest	26	83	5 east	5th	Scattered over the whole surface; some pipe ore found.
	27	83	5 east	5th	Do.
Northwest	27	85	5 east	5th	In large masses.
Southwest	28	85	5 east	5th	Do.
	9, 29	83	6 east	5th	In small fragments, strewed on surface.
	5, 6	84	6 east	5th	Brown hematite in large quantities in the ravines.
	7, 8	84	6 east	5th	Do.
	14, 15, 22, 23	82	1 west	5th	Magnetical node.
	16	83	1 west	5th	
Southeast	15	84	1 west	5th	In considerable loose masses on surface.
Northwest	21	84	1 west	5th	Do.
Northeast	27	84	1 west	5th	Do.
Southwest	28	85	1 west	5th	Do.
		87	4 west	5th	On several sections.
	2 and 3	88	4 west	5th	
Southwest	35	89	4 west	5th	In loose fragments on the surface.
Southeast	34	89	4 west	5th	Do.
		90	4 west	5th	Do.

IRON ORE IN WISCONSIN.

		6	1 west	4th	Scattered in loose masses all over the surface.
		7	1 west	4th	Do.
		8	1 west	4th	In numerous fragments.
Southwest	29	6	2 west	4th	In considerable masses.
Southwest	16	7	2 west	4th	In loose masses on surface.
	8, 7, 18	7	3 west	4th	Do.
Northwest	24	6	4 west	4th	And in other parts of township.
		4	5 west	4th	In many places abundant.
	15, 23	5	5 west	4th	And on many other sections.
		3	6 west	4th	Abundant in many places.
		8	1 east	4th	In loose masses on the surface.
		6	2 east	4th	Do.
		8	2 east	4th	Do.

No. III—Continued.

Part of section.	No. of section.	Township.	Range.	Meridian.	Remarks.
		1	3 east	4th	In loose masses on the surface.
Northeast	19	3	3 east	4th	And in several other sections.
		7	3 east	4th	Strewed all over the township.
West half of	–	2	4 east	4th	On nearly every section.
		3	4 east	4th	Occasionally in loose masses.
		5	4 east	4th	Crystallized, abundant and important.
Northwest	33, extending north into 28	5	4 east	4th	Have been quite productive.
		7	4 east	4th	Large quantities scattered throughout the township.
		8	4 east	4th	Do.
		3	6 east	4th	On east side of township frequent.
		4	6 east	4th	In small pieces.
		5	6 east	4th	In small pieces, frequent.
		6	6 east	4th	Do.
		7	6 east	4th	In small pieces.
		5	7 east	4th	Loose masses on every quarter section.
On	7, 8, 9	6	7 east	4th	Large quantities in loose masses, and occasionally all over township.
	16, 17	6	7 east	4th	Do.
		7	7 east	4th	Large quantities on every section; one vein 3 or 4 feet wide in rock.
		8	7 east	4th	Very frequent, in small pieces.
		9	7 east	4th	Abundant all over township.
		10	7 east	4th	In some places ground literally covered with small pieces.
		4	8 east	4th	Occasionally.
		5	8 east	4th	In numerous loose pieces.
		6	8 east	4th	In small pieces.
		8	8 east	4th	Small masses abundant all over township.
		9	8 east	4th	In loose masses.

No. IV.

Catalogue of the different varieties of geological and mineralogical specimens collected in Iowa, Wisconsin, and Illinois.

[The numbers here given correspond with those on the labels which are attached to the specimens themselves, of which a collection has been made, to form a nucleus of a national cabinet.]

No. 1. The upper stratum of the cliff limestone.

No. 2. Slaty clay of the coal formation.

No. 3. Magnesian limestone, (the cliff rock as it most generally occurs.)

No. 4. Similar to No. 3, but of a deeper yellow color.

No. 5. Similar to No. 3, but full of little cavities, which often contain columns of *crinoïdea.*

No. 6. Compact carbonate of lime, with crystallized carbonate of lime disseminated.

No. 7. One of the upper members of the cliff limestone, as it occurs in the southern part of the Dubuque district, with cavities containing carbonate of lime.

No. 8. Hard white carbonate of lime, containing crystallized carbonate of lime.

No. 9. Resembling No. 3, but of a red tint, and embedding fossil shells; one of the upper members of the cliff limestone in the southern part of the Dubuque district.

No. 10. White limestone in very regular layers, such as occurs above, near Parkhurst.

No. 11. Fine-grained and soft stratum of the cliff limestone.

No. 12. A stratum of the cliff limestone, containing a variety of fossils resembling the rock of South Union, Ohio.

No. 13. Chert, containing columns of *crinoïdea.*

No. 14. Limestone in the southern part of the Dubuque district, containing *orthoceratites.*

No. 15. Hydrated brown oxide of iron.

No. 16. Boulders, detached and worn masses of transported granite, and other crystalline rocks.

No. 17. A fossil coralline—the *lithodendron* of Goldfuss; the *caryophyllia* of Lamarck; the *stylina* of Parkinson; *Atrea rugosa.* H. (*See illustration of No.* 11.)

No. 18. Ferruginous sandstone.

No. 19. Compact limestone at the margin of the great coal field, containing *stylina.*

No. 20. Magnetic boulders, having polarity.

No. 21. A striped rock—a stratum in the cliff formation resembling the building rock below Madison, Indiana.

No. 22. A brecciated carbonate of lime—a limestone made up of angular fragments, at the margin of the great coal field.

No. 23. Sandstone of the coal formation.

No. 24. Limestone containing *trilobites.*

No. 25. Similar to No. 17. The Iowa City marble. (*See plate No.* 7, *figure No.* 6, *after page* 68.)

No. 26. A stratum of the cliff limestone, with glistening crystalline facets of carbonate of lime disseminated, resembling the cliff limestone of Adams county, Ohio.

No. 27. A hydrate of silicia, containing a small per centage of alumina ; similar to the rock which forms the white banks below Cape Girardeau, on the Mississippi—a very white, crumbling variety of chert.

No. 28. The cast of *pentameri.* (*See plate No. 7, figure 3.*)

No. 29. Chain coral (*calamopora escharoides.*) (*See plate No. 7, figure 2.*)

No. 30. Sandstone, with vegetable impressions.

No. 31. Carbonate of lime, crystallized in obtuse *rhombohedrons.*

No. 32. A fossil coralline, resembling the *favosites spongites.*

No. 33. *Pragmoceras.*

No. 34. Sulphuret of lead, (*galena.*)

No. 35. Magnetic boulders.

No. 36. Stalactite.

No. 37. Stalagmite.

No. 38. Cap rock or "rider" closing over the fissures containing lead ore.

No. 39. Brecciated cap rock.

No. 40. Black clay, taken from Hunt's diggings.

No. 41. Red sand, containing oxide of iron, from the same place.

No. 42. Brown clay, from the same place.

No. 43. Nodular magnesian limestone.

No. 44. A gray stratum in the cliff limestone, containing numerous minute fossil shells.

No. 45. Coal shale.

No. 46. Indurated slaty clay, found near Belleview.

No. 47. Bituminous coal.

No. 48. Sulphuret of iron.

No. 49. Sulphuret of iron, with vegetable impressions.

No. 50. Gray stratified limestone, containing a bivalve shell, belonging to the genus *strophomena.* (*See plate 6.*)

No. 51. Fossil coralline, called the *porites?*

No. 52. A *pleurotomaria.*

No. 53. The cast of *pleurotomaria.*

No. 54. A fossil coralline, belonging to the genus *favosites.*

No. 55. A complicated bivalve shell, belonging to the genus *spirifer,* or *delphyris.*

No. 56. A straight many-chambered fossil shell, belonging to the ancient genus *orthoceratites.*

No. 57. A complicated fossil bivalve shell, belonging to the genus *terebratula,* or *atrypa.*

No. 58. A fossil bivalve shell, similar to the last, without a perforation at the beak ; *atrypa.*

No. 59. A fossil bivalve shell, very much compressed, one valve concave, the other convex, hinge straight, no perforation ; belonging to the ancient genus *strophomena.* (*See sketch No. 7, plate No. 7, figure 4.*)

No. 60. A tooth-like fossil, *dentalium?*

No. 61. A flat fossil shell, something like a *pleurotomaria,* (probably new.)

No. 62. A compressed spiral univalve, resembling a *cirrus.*

No. 63. A fossil coralline ; (the *columnaria?*)

No. 64. A fossil zoophyte, belonging to the genus *astrea.*

No. 65. A black slate.

No. 66. *Entrochites ;* joints of a fossil marine radiated animal, belonging to the order *crinoïdea,* popularly called *stone lilies.*

No. 67. A fossil coralline, belonging to the genus *coscinopora*. (*See plate No. 7, figure 5.*)

No. 68. Chert—a variety of flint.

No. 68'. Chert, associated with the lower magnesian limestone on the Wisconsin river.

No. 69. Flint.

No. 70. Chalcedony.

No. 71. Carnelian.

No. 72. Agate.

No. 73. A coralline, belonging to the genus *cyathophyllum*.

No. 74. Quartz.

No. 75. Bog iron ore.

No. 76. Argillaceous iron ore.

No. 77. Water limestone, (an argillaceous limestone.)

No. 78. Magnetic iron, (found only in boulders.)

No. 79. A light gray compact building rock.

No. 80. The cliff limestone, as it is found in the walls of the lead-bearing fissures.

No. 81. Part of a many-chambered marine fossil shell, resembling a *belemnite*, but probably the termination of certain *actinoceras*, found in a stratum six inches thick, at Eagle point, fifteen feet above low water, on the Mississippi; the stratum containing numerous *strophomena* immediately below this stratum.

No. 82. A blue or gray fossiliferous limestone, below No. 79.

No. 83. A bivalve fossil shell, resembling the genus *nucula*.

No. 84. Brown magnesian limestone, containing casts of bivalve fossil shells.

No. 85. Stratum of blue limestone, containing a long spiral univalve fossil shell—*turritella obsoleta ?*

No. 86. Indurated shale, or slaty bituminous clay.

No. 87. Stratum in the cliff formation, of a slaty structure, and brownish yellow color.

No. 88. Stratum in the cliff formation, of a bluish gray color.

No. 89. *Syringopora*—a fossil coralline.

No. 90. Stratum of the cliff formation, affording a fine building material—a magnesian limestone.

No. 91. Stratum of blue or gray limestone, below No. 81.

No. 92. *Anthophyllum*—a fossil coralline.

No. 93. White crystalline limestone, from the western part of the Dubuque district.

No. 94. A fossil coralline, resembling *stylina*, (probably new.)

No. 95. A fossil coralline, resembling *astrea*, (probably new.)

No. 96. *Calamopora basaltica*.

No. 97. A fossil coralline, (probably new.)

No. 98. The upper sandstone in the townships ranging near the Wisconsin river, and north of Turkey river, below the buff-colored rock; of various colors—white, yellow, red, and sometimes variegated with stripes of white, yellow, and red. (*See diagram No. 6, plate No. 16.*)

No. 98'. Lower sandstone, just above the water level at Prairie du Chien; often very soft and crumbling. (*See diagram No. 6, plate No. 16.*)

No. 99. Argillaceous limestone.

No. 100. Oölitic chert, a stratum in the equivalent of the Missouri limestone on the Wisconsin river.

No. 101. Conglomerate sandstone.

No. 102. Buff-colored stratum, above No. 98.

No. 103. Blue limestone, (*see diagrams Nos.* 4, 5, *and* 6, *plates Nos.* 14, 15, *and* 16,) containing *strophomena.* (*See illustrations of No.* 59.)

No. 104. Stratified white carbonate of lime, containing a spiral univalve, resembling a *pleurotomaria*—a stratum in the blue limestone.

No. 105. A yellow rock with fossils, on Turkey river, perhaps the equivalent of No. 102.

No. 106. Paradoxides?

No. 107. A red rock, with fossil impressions.

No. 108. A magnesian limestone, below No. 98; is an equivalent of the Missouri limestone. (*See diagram No,* 6, *plate No.* 16.) This rock is also numbered 3'.

No. 109. Similar to No. 108, from the same geological position.

No. 110. Wisconsin copper ore, (a hydrous di-carbonate of the oxide of copper, with a variable admixture of oxide of iron, and sometimes a little sulphuret of copper.)

No. 111. Stratum in the Missouri limestone.

No. 112. Building stratum in the equivalent of the Missouri limestone, just above the lower sandstone, No. 98'.

No. 113. A stratum in the equivalent of the Missouri limestone.

No. 114. A porphyritic boulder.

No. 115. Boulder of siliceous slate.

No. 116. Very rugged masses of quartz found with No. 108, similar to those found in the lead region of Missouri.

No. 117. Boulder of hornblende.

No. 118. Ferruginous sandstone, below the blue limestone formation.

No. 119. The stratum No. 98, passing into a quartz rock.

No. 120. Argillaceous limestone—a stratum in the blue limestone formation, similar to that used in Cincinnati for curbstones.

No. 121. Carbonate of lead.

No. 122. Sulphuret of zinc, (black-jack.)

No. 123. Carbonate of zinc, (dry bones of the Wisconsin miner.)

No. 124. Hornstone.

No. 125. Gray clay from the diggings.

No. 126. Lowest stratum of the cliff limestone, above the blue limestone.

No. 127. Calcareous tufa, (a deposite from lime water.)

No. 128. Marl, associated with No. 82.

No. 129. Chert, containing *strophomena.*

No. 130. One of the lower beds of the blue limestone, containing numerous small shells.

No. 131. Sulphate of *barytes,* from Mineral Point and Gratiot's Grove diggings.

No. 132. Lowest rock on Rock Island; four feet exposed above low water of the Mississippi.

No. 133. A shelly white carbonate of lime, above No. 132, twelve or fifteen feet thick.

No. 134. Brecciated limestone, above No. 133, one foot thick.

No. 135. Similar to No. 133.

No. 136. White siliceous rock, with fossils, something like No. 27.
No. 137. Black lead ore, (carbonate of lead, with a little galena.)
No. 138. Light gray stratum, from the new diggings in township one, range one east of the fourth principal meridian.
No. 139. Radiated and capillary *pyrites*, from the White-oak Springs, near the Illinois line.
No. 140. Sulphate of barytes, with carbonate of zinc, sulphuret of zinc, and sulphuret of lead, from Mineral Point diggings.

NOTE.—Of the fossils collected, many are probably yet undescribed; but until the receipt of several recent works of reference on organic remains, I am unable to determine this point.

NEW HARMONY, INDIANA, *February* 9, 1840.

DEAR SIR: Last week, the last of the township maps containing our annotations were forwarded to your office. The general report will not be completed for several weeks; the maps, diagrams, illustrations, lists, and analyses of ores and minerals, intended to be imbodied and to accompany it, requiring much time and consideration.

By this post I send you the appendix, containing notes giving a description of the individual townships, and embracing details intended chiefly for reference; at the end will be found two tables, showing the proportion of prairie and timber in the Dubuque and Mineral Point districts, and a descriptive catalogue of the different varieties of specimens to be forwarded to Washington as soon as those collected in Wisconsin arrive. Since we finished our operations at Stephenson, the winter has been so severe, and the snow so continually on the ground, that it has been impossible to make the examination of the townships in Illinois, in the neighborhood of Shawneetown. By the time my report is completed, I shall be prepared with a corps of from six to eight, to proceed with the examination, unless I receive, in the mean time, instructions from you to the contrary.

No communications have been received from you since my last letter.

I am, very respectfully, your obedient servant,

DAVID DALE OWEN,
Principal Agent, &c.

Hon. JAMES WHITCOMB.

P. S.—I find it necessary to retain the catalogue until the analysis of several ores and minerals, which I am now making, is completed, and drawings are made, to which it will be frequently necessary to refer.

APPENDIX,

CONTAINING A PARTICULAR DESCRIPTION OF EACH TOWNSHIP.

NOTE.—The numbers designating specimens refer to corresponding numbers on the labels of the different specimens forwarded to the department, to form a nucleus for a national cabinet. A descriptive catalogue of these specimens, with the numbers prefixed, is annexed to this appendix.

For the particulars of occupancy and claims, the department is referred to the annotations on the township maps herewith forwarded.

All the diggings of importance, and all the new discoveries of lead ore, are indicated on the general map, and on the township maps, by dots of vermilion, and (No. 34) the number of "sulphuret of lead" in the catalogue and national cabinet; dots of green and (No. 110) represent, in like manner, the copper diggings and discoveries of copper; dots of yellow *ochre* and (No. 15) indicate hydrated brown oxide of iron; dots of yellow *gamboge* and (No. 123) indicate localities of carbonate of zinc and calamine.

Description of the individual townships, showing the face of the country, proportion of prairie and timber, how watered, nature of the soil, and the kind of rocks and minerals.

IN RANGE ONE WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—Nine-tenths rich rolling prairie; one-tenth timber. On Mud creek, hickory, oak, hackberry, and walnut. On *Pine* creek, oak, hickory, and a little pine. Pretty well watered in the southeast, northwest, and northeast. Soil: good second rate; rather sandy, particularly near Mud creek. Sub-soil: clayey. Rock: on southwest corner of 26, on *Pine* creek, are found specimens similar to No. 19; some ferruginous sandstone, similar to specimen No. 18, on *Pine* creek. On northeast of 1, a little hydrated brown oxide of iron, like specimen No. 15, and a little argillaceous iron ore, with loose masses of specimen No. 19.

Township 79.—Entirely rolling and broken prairie, with the exception of the borders of *Mud* creek, and a few insignificant groves of stunted timber interspersed throughout the township. A little good oak timber on *Mud* creek; not well watered. Soil: generally third rate, sandy, light colored, except on the creek. No rocks discovered.

Township 80.—About four-fifths broken prairie; about one-fifth good oak timber, in the northeast corner, on the creek; not well watered, except in the northeast corner. Soil: third rate, light, sandy; some loose masses of limestone in the northeast, on the creek.

Township 81.—Chiefly broken prairie; some scattering stunted oak and hickory bushes; and on the creek, in the north, a little good timber; not well watered, except in the north. On 15, some loose masses of siliceous limestone, (specimen No. 3;) on 9 and 10, numerous boulders, (specimens No. 16.)

Township 82.—All rolling prairie, except the northeast corner, on the east side of *Wapsipinecon* river; well timbered on 1, 12, and part of 11, with white and black oak; not well watered, except in the northeast corner. Soil: third rate, light colored, sandy. Sub-soil: coarse sand. Rock: (specimen No. 3) between 22 and 15; also hydrated brown oxide of iron in loose fragments, (specimen No. 15.) A very large granite boulder on southeast of 1, twenty-five feet in diameter, fourteen feet high.

Township 83.—Mostly rolling prairie; a strip of timber along *Wapsipinecon* river; a grove of hickory and oak on the southwest quarter of 16, and some scattering timber on 1, 12, and 13; well watered in the south, but not in the north. Soil: third rate; coarse sand, light colored; small bottoms along the river, pretty good soil; some rock (specimen No. 3) in the centre of the township; some boulders on 34, 27, and 33, several of them very large; on 16, some pieces of iron ore, (specimens No. 15.)

Township 84.—Chiefly broken prairie; some timber along *Bear* creek; good timber on 25 and 26; dwarf-oak growth on the creek towards the north, and occasionally bushes through the prairie; tolerably well watered; some good springs. Soil: third rate, clayey, light colored. Sub-soil: clay. Numerous cliffs of rocks along *Bear* creek, like specimen No. 12, with crystallized carbonate of lime, (specimen No. 31;) siliceous masses scattered over the township; some loose masses of iron ore (specimen No. 15) on the surface, principally on southeast of 15, northwest of 21, and northeast of 27.

Township 85.—Nearly half prairie; surface very broken on *Mineral* creek and on the *Makoqueta* river; good black and white walnut timber in the east and south; well watered. Soil: generally clay; the small bottoms, along the cliffs, rich; the ridges third rate land; township full of rocky cliffs, (specimen No. 12,) containing fossils, (specimens Nos. 54, 56, and 73.) Specimen No. 31 very common, disseminated, or in crevices, in the rock; a great variety of flinty masses similar to specimen No. 68. On southwest of 28, some iron ore, (specimen No. 15.) Here are also diggings, and some lead ore has been discovered, but no body of it found; it is supposed that there has not been more than one hundred pounds raised.

Township 86.—About two-thirds rolling prairie; about one-third good oak timber, chiefly strips along the north fork of the *Makoqueta* river, also along *Farmer's* creek, and a branch of the Makoqueta river in the northeast; very well watered, both by streams and springs. Soil: generally second rate; along the stream, and on east side, land broken. Sub-soil: clay. Rock: specimen No. 3 very frequent with specimen No. 31. Fossils: specimens Nos. 51, 29, and 54. No diggings. No appearances of lead ore.

Township 87.—About three-fourths broken prairie; one-fourth timber, chiefly stunted, with some spots of good quality; well watered by streams and springs. Soil: along *Whitewater* creek, second rate, rather sandy, dark colored. Sub-soil: mostly clay; the rest of township, surface broken. Rock (No. 3) frequently exposed in cliffs with specimen No. 31 imbedded. Fossils: specimens Nos. 51 and 73; some agate (specimen No. 72) found in this township on 22.

Township 88.—The greatest part high, broken prairie; in the northern part of the township, very thin openings; remarkably well watered by streams and springs. Soil: first rate, upland, rather dark sandy loam; the

soil of this whole township is nearly as good as in the valleys generally. Sub-soil: sandy. Rock (No. 3) often exposed in cliffs; no appearances of lead ore.

Township 89.—About seven sections rolling prairie; the rest very broken timbered land; pretty well timbered generally; on the ridges, considerable basswood and American aspen; well watered by streams and springs. Soil: second rate, clayey. Cliffs (specimen No. 3) containing fossils (specimens Nos. 54, 29, and 64.)

Township 90.—Eight or nine sections in the west, rolling prairie; also, part of 15 and 23; the rest of the township broken timbered land; the southwest corner is oak openings; well watered both by streams and springs. Soil: in the timbered land, second rate, sandy, rather dark; a small strip of bottom along the north fork of *Little Makoqueta* river first rate. Numerous rocky cliffs, (specimen No. 3;) on northwest of 9, below specimen No. 87, a bluish green clay. The northeast half of this township shows symptoms of lead ore. There are, however, no productive lodes at present discovered. Some iron ore (specimen No. 15) on southwest of 9; also, on northeast of 8, and northwest of 4; but no extensive bodies of it discovered. On the southwest of 28 a crevice was struck, but no lead ore was found.

Fractional township 91.—Little or no prairie; high and broken land, and precipitous cliffs. Timber: chiefly oak. Well watered by streams and springs. Soil: second and third rate; clay. Rock on top of bluffs, like specimen No. 79; below, specimen No. 91. Diggings on 35 and 36; about five hundred pounds supposed to have been raised.

IN RANGE TWO WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—About two-thirds prairie; east half, high, rolling, sandy prairie; the part near *Cedar* river, low, level, and sandy. Groves of timber between *Cedar* and *Sugar* creeks; some heavy timber near the mouth of Sugar creek, chiefly elm and water oak; thinner towards the northeast, where the ridges are covered with white oak; well watered in the northwest. Soil: third rate, sandy, light throughout; on the southeast, destitute even of grass. No rocks visible on the east side of *Cedar* creek; on the west side, rock (specimen No. 5.)

Township 79.—The eastern portion, two-thirds broken prairie; the western part, broken barren ridges, covered with a dwarf-oak growth; on *Sugar* creek, some pretty good timber. Soil: third rate, generally sandy, and light colored, better than in township 78. The first ledges of rock found in this range (specimen No. 3) near the middle of the township.

Township 80.—About four-fifths rolling prairie; groves along *Sugar* creek and *Crooked* creek; about one-fifth timber; burr oak on the ridges; basswood and white oak near the streams, on the richer part of the township; west half well watered. Soil: second rate, rather sandy. Sub-soil: clay. No ledges of rocks visible in this township.

Township 81.—The whole of this township is rolling prairie, except three spots of timber, generally burr oak, occupying about one section. Soil: second rate, rather sandy, light colored, except on the surface. No rocks visible, except a few boulders.

Township 82.—All prairie, except one grove, partly on 14 and partly on 11; not very well watered. Soil: second rate, rather sandy. Ledges of

rock on *Yankee* run, chiefly on 10, 14, 15, and a few on 22, similar to specimen No. 3.

Township 83.—Chiefly broken and rocky prairie; about one-fourth timber, lying on the *Wapsipinecon* river, and a grove of about one section; on the river the timber is chiefly white oak. Not well watered, except in the middle of the township. Soil: sandy; in the south, second rate; in the north, third rate. Rocks appear on the points of the hills, similar to specimens Nos. 12 and 3; in the south, some large boulders, (specimen No. 16.)

Township 84.—Principally broken prairie; some scattering black oak through 31, 32, 33, and 34; no other timber, except some bushes. One small stream (*Bear* creek) runs through this township; very few good springs observed. Soil: third rate, sandy. Very few rocks; at a few points, specimens No. 12 and No. 3; a good deal of chert scattered near these rocky points. This is a poor township.

Township 85.—About half broken prairie; one-half pretty good timber along the *Makoqueta* river, principally white and black oak; some basswood and walnut. But few small streams; watered in the south by *Mineral* creek, in the north by the *Makoqueta* river. Soil: second rate, sandy; on the river, third rate. Surface very broken and rocky north of the *Makoqueta* river; cliffs of specimen No. 3 containing fossils (specimens Nos. 51, 73, and 89;) on 11, fossil (specimen No. 28) is found. Not much rock south of the *Makoqueta* river.

Township 86.—One-third broken prairie in the southeast; two-thirds timbered land; pretty good timber on 16, 17, 19, and 20; tolerably well watered by streams and springs. Soil: in the north and west, first rate, upland prairie; in the southeast, second rate, broken timbered land. Rock: specimen No. 3. Fossils: specimens Nos. 28, 64, and 59.

Township 87.—The east half, very broken prairie; west half, broken woodland; timber stunted, black and white oak; tolerably well watered. Soil: sandy, with a great many fragments of chert disseminated through it; second rate in the southeast; in the north and west, third rate. Rock (No. 3) containing fossils (Nos. 28 and 56.)

Township 88.—About five-sixths rolling prairie; in the west, some good black and white oak timber on the western range of sections; some spots of timber in the southeast; tolerably well watered by streams and springs. Soil: rather clayey; second-rate land generally. Rock (No. 3) with fossils (No. 29 and No. 73) are found. A piece of lead ore found on 18, but no important discoveries made; not much indication of lodes of lead ore.

Township 89.—All prairie, except thin openings in the north; very well watered by streams and springs. Soil: good second rate, rather broken, fine, black, sandy. Sub-soil: rather sandy. Rock of this township is specimen No. 3, with fossils (Nos. 28 and 29.) No diggings; no discoveries of lead ore. Land very much broken in the north and northeast.

Township 90.—About three sections of prairie. All the middle and eastern part of township, oak openings; pretty well watered. Soil: fine, light mixture of sand and clay. Rock (No. 2) containing fossils (Nos. 29, 28, and 54.)

Fractional township 91.—No prairie; all heavy timber, except some oak openings in the extreme south; in the bottom, black walnut, ash, elm, and maple; on the ridges, varieties of oak. Well watered by *Great Turkey* river, *Little Turkey* river, and *Blue Belt* creek, in the east. Soil: in bot-

toms, first rate ; the rest second rate, but surface very broken. Rocks: specimens Nos. 3 and 80 above, and Nos. 90 and 91 below; some good building rock at the bottom of the bluffs (specimen No. 90.) Diggings commenced on the northwest of 11, and lead ore discovered; a little lead ore raised on southeast of 7; there has been, however, no quantity of ore raised in this township as yet.

Fractional township 92.—Little or no prairie, except a strip of prairie bottom on 8 and 17; good timber on the south and along the eastern border; the rest is principally a dwarf growth of timber on the ridges. Tolerably well watered. Soil: first rate on the prairie bottom; near "Prairie Laporte" and narrow bottoms along the creeks, second rate and wet. Sub-soil: gravelly and rocky. Cliffs of specimens No. 3 and No. 68 (chert) common. On northwest of 7, discovered a quantity of lead ore in a ravine; twenty-five pounds were procured in a few minutes; there is probably a valuable lode here.

Fractional township 93.—No prairie; the bottoms are well timbered; on the bluffs a growth of shrubs; the bottoms are not extensive. Soil: on the bluffs, third rate ; bottoms, second rate, wet. Sub-soil: in the bottoms, clay; in the bluffs, clayey and rocky. Rock: Nos. 3 and 80, with specimen No. 68, (chert.) No discoveries of lead ore, although there are many indications of it.

IN RANGE THREE WEST OF FIFTH PRINCIPAL MERIDIAN.

Township 78.—All gently rolling prairie, except about two sections of timber on the *Wapsipinecon* river, of white and black oak; well watered only in the northwest and southeast. Soil : third rate, light, sandy. Sub-soil: clay. Northeast of 1, rock similar to specimen No. 24, containing numerous fossils, (specimens Nos. 106, 55, 57, and 58.)

Township 79.—Rolling prairie; rather broken near *Red Cedar* river; belt of good timber along *Red Cedar* river, of white and black oak, and basswood; well watered. Soil: third rate, light, sandy. Rock (No. 24) along the bluffs of *Red Cedar* river.

Township 80.—All thinly timbered; principally white oak and black oak; land gently rolling ; well watered by *Cedar* river and its branches. Soil: first rate. Sub-soil: clay. Rock (No. 3 and No. 21) on southwest of 3. This is a most beautiful township.

Township 81.—Rolling prairie, except about four sections, which are groves of white oak and basswood; pretty well watered. Soil: second rate, sandy, light colored. Sub-soil: clayey. Rock (No. 3) with columnar structure.

Township 82.—All rolling prairie, except a little scattering timber in the northwest, and a little grove on 18 and 19 ; badly watered. Soil: third rate, sandy, light colored. No rock visible.

Township 83.—About two-thirds prairie, interspersed with fine groves of timber; well watered. Soil: second rate, light colored, and fine. Rocks: Nos. 3 and 12.

Township 84.—North of *Wapsipinecon* river, rolling prairie. The only timber is on the *Wapsipinecon* river, and a little scattering timber in the northeast, on 1, 2, and 12; the timber on *Wapsipinecon* river is rather indifferent. Not well watered, except in the south. Soil: third rate, sandy, particularly on the river. Sub-soil: clay. Rock frequently exposed on

the north side of *Wapsipinecon* river; also, on northwest of 33, south of the river. (Specimens No. 3, with fossils Nos. 29 and 73.)

Township 85.—Almost all rolling prairie, with some wet sloughs; in the northwest, surface broken; about three sections of timber, partly in 26, 34, 35, and 36; very badly watered—only two insignificant creeks. Soil: second rate, but wet. Rock is exposed chiefly in north and northeast, (specimen No. 3;) magnetic boulders on northwest of 4, on the ridges.

Township 86.—One-half rolling prairie; surface rather broken in the southwest; one-half thinly timbered with white and black oak; and in the bottoms, cottonwood; maple, ash, and basswood, along the south fork of *Makoqueta* river; some good timber in the northwest. Pretty well watered. Soil: on the river, second rate, sandy; the rest, third rate, sandy. Rock frequently exposed all over the township, (specimen No. 3,) containing fossils (Nos. 73 and 63.)

Township 87.—Chiefly prairie; surface broken on the east line; also, on 17, 20, 22, and 27; the rest rolling. About seven sections of timbered land; the timber on 31, 32, and 30, very good; the rest average timber. Not well watered; no springs. Soil: in the southwest, second rate, sandy; in the prairie, third rate. Sub-soil: in places, clay. Rock well exposed on the east; also, on 22, 27, 17, 34, and 35; on northeast of 24, large orthoceratites (specimens No. 56, also No. 64;) southwest corner of 1, fossil (No. 29.)

Township 88.—Six-sevenths rolling prairie; one-seventh stunted white and burr oak timber—chiefly along the streams. Well watered both by streams and springs. Soil: second rate, sandy, with flinty fragments; in the middle of the township, black. Sub-soil: yellow clay. Rock (No. 3) containing fossils (Nos. 28 and 95.) No appearances of lead ore.

Township 89.—Mostly all rolling prairie; no timber of any value; not well watered, except by *Bear* creek. Soil: third rate, with flints; some little of the soil is clayey in the oak bushes on 15 and 16. Rock, No. 3; fossils, Nos. 29, 54, and 94. The *millstone quarry* mentioned by the surveyors is merely granite boulders, and a cliff of specimen No. 3, above. On the northwest of 4, where the surveyors note appearances of lead ore, nothing but siliceous masses of chert (specimen No. 68) is to be found. This alone cannot be considered evidence of the existence of lead ore. On the northwest of 14 is a magnetic boulder, with polarity. This is a poor township.

Township 90.—Three-fourths prairie: good timber in the northeast: sugar tree and basswood in the low ground, oak in the high ground. Pretty well watered by streams and springs. Soil: first rate, black; land rather broken in the southwest; soil second rate in the northeast; surface very broken. Rock, No. 3; fossils, No. 29. No indication of lead ore except sink-holes.

Township 91.—No prairie; well timbered with sugar maple, walnut, hickory, and oak; surface very broken and hilly; well watered by streams and springs. Soil: third rate, clayey. Rock, No. 3, with No. 31. No indication of lead ore on the surface.

Township 92.—About two sections of rolling prairie, with some scattering timber, partly on 3, 4, 9, 10, and 15; the rest of the township is timbered with a variety of pretty good timber; not well watered, except in the west. Soil: on the ridges, third rate, clay. Sub-soil: clay. Soil in the bottoms first rate, but not extensive. Rock: generally specimens

Nos. 3, 26, and 80, with fossils Nos. 63 and 67. An indurated clay slate on southwest of township 86, on high ground, near the head of a stream running to the southeast corner of this township. A mineral (specimen No. 27) white siliceous rock, which, by decomposing, forms a material used for porcelain, similar to that on the *Mississippi* river, below Cape Girardeau, is found frequently in this township; it passes, however, rather too much into hornstone. Some (specimen No. 15) iron ore found on southeast of 13. Lead ore found on the southwest of 1. No discoveries in the west of the township. The northeast half is included in the lead region.

Fractional township 93.—About four sections rolling prairie; the rest timbered; on the tops of the ridges the growth is stunted; surface of timbered land, broken; well watered by streams and springs. Soil: clayey mould. Sub-soil: clay. More sand in soil of the eastern part of the township; bottoms first rate, but rather narrow; upland in the west, second rate in the timber, first rate in the prairie; upland in the east, third rate. Not many ledges of rock in the west part of the township; specimen No. 3 exposed in the east. A little argillaceous iron ore on southwest of 35. No lead ore discovered; the eastern part of the township shows some indications of lead ore.

Fractional township 94.—About three sections of open prairie in the southwest corner; the rest thinly timbered with white oak, basswood, burr oak; in the west, sugar maple, and basswood in the low ground; scattering oak on the ridges; pretty well watered by streams and springs. Soil: in the narrow bottoms, first rate; in the ravines and on the ridges, third rate, except in the extreme north, where it is second rate; clay appears to predominate as an earthy ingredient; many loose fragments of rocks disseminated. Rocks: No. 102 above, No. 98 below, and Nos. 3 and 100 still lower.

Fractional township 95.—No prairie of any extent; the most of the township timbered with a thin growth of oak, sugar maple, basswood; no extent of bottom; pretty well watered, except on the bluffs on the east side. Soil: third rate on the ridges in the east; in some parts of the west, second rate; in the narrow bottoms, first rate; very rocky in the east, clayey in the west. Near the *ferry*, on the *Mississippi* river, opposite "Prairie du Chien," rock (No. 101) is exposed about fifteen feet above the water; some of specimen No. 15 near *Bloody* run. No claim, except that of Basil Giard.

IN RANGE FOUR WEST OF FIFTH PRINCIPAL MERIDIAN.

Township 78.—Two-thirds prairie; the low prairie rather swampy; the rest rolling. One-third timber, chiefly on the *Wapsinonox* river, red oak, elm, and black walnut; three small groves, one in 30, the others in 31 and 33. East side well watered by the *Wapsinonox* river. Soil: first rate in the northeast; the rest second rate, dark, three feet thick. Sub-soil: three feet clay, sand below. No rocks discovered. In 3, a chalybeate spring discovered.

Township 79.—Nearly all rolling prairie, with some hazel bushes; some timber, chiefly on 33, at the head of the Wapsinonox river; twenty or thirty acres of timber (called "Hickory Grove") on the northeast of 10, (not on the east of the creek, as noted on the surveyor's plat.) Soil: second rate, dark. Sub-soil: clay. Not very well watered, except in the south. Rock: in the northeast, on 10 and 3, siliceous and calcareous, (specimen No. 25,) with fossil (*stylina.*)

Township 80.—Three-fourths prairie; rolling in the south; surface broken along *Red Cedar* river in the northeast; one-fourth stunted timber; on *Red Cedar* river, a little stunted scattering black oak and hickory. Soil: some first-rate black soil in the prairie, in 2, on *Red Cedar* river; in the northwest quarter of the township, soil third rate, yellow; the rest, second rate, dark; soil generally sandy. Sub-soil: in the hills, clayey. Well watered, especially in the northeast, on southeast of 10, southwest of 11, northwest of 14, and northeast of 15. Rock (No. 3) containing fossil, (No. 56,) on the northeast of *Red Cedar* river.

Township 81.—Three-fourths prairie; rolling, except in southeast, where it is flat; and about two sections in 17, 21, and 18. Good timber occupying about nine or ten sections; chiefly white and black oak and hickory. Well watered. Soil: in the southeast, first rate; in the west, second rate flat prairie; first rate in the north, black soil. On 16, 10, 11, and 19, rock, (No. 3;) also, slaty limestone, (No. 10.)

Township 82.—Rather more than one-half flat prairie; some pretty good oak timber in the northeast, and in the north half of 5 and 4; stunted oak timber in the southwest. No water in the northwest; small creek in the northeast; and southwest not well watered. Soil: in the northeast, first rate; also in the northwest; in the southeast, light, sandy. Sub-soil: clay, then sand. Rock on 9, (specimen No. 3;) on northeast of 29, (specimens Nos. 12 and 3.)

Township 83.—Rolling prairie, except three or four sections. The groves of timber are basswood, black walnut, and white oak. Not well watered. Soil: first rate, black, except in the northeast corner, which is second rate. Sub-soil: in some places, clay. Rocks: on the middle of 15 some specimen, (No. 3,) but no ridges or ledges of limestone, as represented on some of the maps.

Township 84.—About nine sections, in all, rolling prairie; two sections broken prairie; about twenty-five sections of timber, heavy on the southwest of the *Wapsipinecon* river; pretty well watered by the *Wapsipinecon* river, by the *Buffalo* creek in the north, and by a small creek in the centre. Soil: in the prairie upland, generally first rate, except in the northeast, where the surface is broken and soil third rate; in the timber on the *Wapsipinecon* river, surface broken, soil second rate, sandy. Sub-soil: sand. Numerous ledges of specimen No. 3 exposed.

Township 85.—Three-fourths very rolling prairie; one-fourth timber, generally of a thin growth of white oak, black oak, and burr oak; on 31 and 32, land broken, but timber good; some small groves of stunted timber in the northeast; poorly watered, except in the southwest corner. Soil: in the prairie, second rate; in the northeast, third rate; in the southwest, poor third rate, except on southwest side of *Buffalo* creek, where it is second rate. Sub-soil: sand. Some ledges of specimen No. 3 on *Buffalo* creek. Rock not often exposed in the centre and north.

Township 86.—Eight-ninths rolling prairie; one-ninth timber; on the northeast corner, good quality of basswood, black walnut, cherry, sugar maple, white oak, and black oak; not very well watered; a good spring on southwest of 10. Soil: generally first rate; in the northwest second rate, and surface broken; northeast, in the timber, second rate; second rate also in the southeast, and rolling. Some compact carbonate of lime on the northeast of 10; also, ledges of specimen No. 3, with fossil No. 54 ("calamopora") on southeast of 3.

Township 87.—One-third rolling prairie; some low flinty hills; two-thirds second rate timber; on 4, some first rate timber, on 13, 24, and 25, black and white oak, sugar maple, basswood and ironwood; barrens in 1, northeast of 2 and 12 third rate; well watered by the *Makoqueta* river and Limestone creek, (called by the settlers Buck creek;) two good springs on the northeast of 27 and southeast of 27. Soil: first rate on 28, 33, 18, 7, 22, and 8; second rate on 19, 20, 21, 29, 30, 31, and 32; second rate and surface broken on 5 and 6; soil generally sandy, but dark. Sub-soil: sand and gravel. Full of rocky cliffs, (specimen No. 3;) some (specimen No 15) on 6, 7, 8, 16, and 17; magnetic boulders on 35 and southwest of 21.

Township 88.—One-fourth broken and rolling prairie; three-fourths timber of various kinds; on the eastern sections a light growth of white, red, and burr oak, and basswood; sections 8, 9, 11, 14, 15, 16, 17, and 36, about one-half tolerable growth of red, white, black, and burr oak, and basswood; on 18, 23, and 28, one-fourth same kind of timber; on 19, 20, 21, 28, 29, 30, 32, 33, and 34, all timber—mostly a heavy growth of white and red oak, white ash, hickory, and basswood; well watered by beautiful limpid streams, and a number of fine springs of excellent water. Lake *Chester* (on the corners of 16, 17, 20, and 21) is a very clear sheet of water, with a shore of gravel; the depth of water, on an average, is thirty feet. Soil: good second rate, generally sandy. Sub-soil: in some parts sand, in some parts a yellow clay. Iron ore (No. 15) in detached fragments is very abundant on 2 and 3, and on those sections which range south from them, with broken masses of rock (No. 3) and chert, (No. 68.) Several ledges of specimen No. 3 in various parts of the township.

Township 89.—All but two sections rolling prairie; one grove of good hickory and white oak timber, partly on 8, 9, 16, and 17; the rest is dwarf timber; tolerably well watered by *Plum* creek and several good springs. Soil: second rate; sandy, with fragments of chert disseminated. Sub-soil: yellow clay. Large cliffs of specimen No. 3 on specimen No. 25; fossils, (Nos. 54 and 94.) No appearance of any valuable quantity of iron ore or lead ore; some pieces of iron ore (No. 15) on southwest of 35 and southeast of 34.

Township 90.—The south half is broken prairie; north half timbered; good timber on *Elk* creek—a variety, but chiefly oak; well watered both by streams and springs. Soil: third rate, clayey. Sub-soil: clay. Cliffs of specimen No. 3 on the streams; fossils Nos. 28 and 54; some fragments of specimen No. 15 loose on the surface.

Township 91.—No prairie; all a tolerably heavy growth of sugar maple, walnut, hickory, and oak; surface very broken and hilly; well watered both by streams and springs. Soil; second rate. Bottoms on *Elk* creek half a mile wide; rich soil, first rate. Rock of the township, specimen No. 3. No discoveries or indications of lead or iron ore.

Township 92.—About three sections of high broken prairie, on Turkey river, is good heavy timber, but surface of land very broken; a great proportion of sugar-maple on 22, 26, 27, 34, and 35; very well watered by streams. Soil: in timbered land in the northeast, second rate; all the rest third rate, rather sandy, gravelly bottom. Rock of the township, specimen No. 26; also, some of specimen No. 80; some magnetic boulders.

Township 93.—One-half rolling prairie; one-half timber; heavy oak in the west; in the south, oak openings; pretty well watered. Soil: all

third-rate, except the rolling prairie in the northeast; light and sandy on the ridges; in the prairie, a sandy mould. Sub-soil: generally sandy. Rock in ledges, (specimen No. 3 above, No. 90 and No. 91 beneath.) The commencement of the blue limestone in this range.

Township 94.—Five-sixths prairie; in the west, surface broken; in the centre and south, high and rolling. A small grove of timber partly on 5 and 6; also, a thin growth of timber on 1, 2, 11, 12, 13, and 24, and a little on 25. Not very well watered. Soil: sandy mould, generally second rate, except in the west, where it is third rate. Sub-soil: generally clay. Rocks, (Nos. 3, 90, 91, 98, and 16.) The only ledge seen is in the northeast.

Township 95.—About one-third high rolling prairie; about two-thirds timber; good timber on 1, 2, 3, 12, and part of 10, 15, 16, and 21, and on 25, 26, 35, and 36; the rest is a stunted growth; well watered only in the centre and east. Soil: generally fine, light, and sandy. Sub-soil: sand, with a mixture of clay. Rock, (No. 3 above, Nos. 90 and 91 beneath.) Fossils, (Nos. 59, 62, and 97.)

IN RANGE FIVE WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—Mostly all high rolling prairie; in the east part, some low, wet, and rather marshy spots; two small groves of timber—one of oak, in the northwest; the other in the southwest, of oak, hickory, and ash: in all, about one section. Not well watered; a few good springs. Soil: in the prairie second rate, rather gravelly on the ridges, southern part wet, soil black. No rocks observed in this township.

Township 79.—The southern half is high rolling prairie; one-third timber; in the northwest, groves of oak and hickory, with openings of dwarf oak and hickory; pretty well watered. Soil: in the prairie, second rate; in the timbered land, third rate. No rocks discovered in this township.

Township 84.—Four-fifths broken prairie; one-fifth timber, in groves of oak, basswood, and some sugar maple; well watered by Big creek and cold springs. Soil: in the west part second rate, light and gravelly in the prairie, in the east part third rate. Great numbers of large boulders scattered over the prairie. Rock on 12, similar to specimen No. 7, (one of the upper members of the cliff limestone;) on 31, siliceous limestone, similar to specimen No. 3, with chert (No. 68) and fossil (No. 32.)

Township 85.—Four-fifths high rolling prairie; one-fifth groves of timber and barrens; the timber is chiefly black, white, and burr oak; well watered by *Buffalo* creek and *Wapsipinecon* river. Soil: generally third rate, light colored, and gravelly. Rock (Nos. 3 and 12) on both sides of *Wapsipinecon* river, but principally between the two streams; contains fossils (No. 54) and one resembling No. 64.

Township 86.—Four-fifths dry rolling prairie; one-fifth timber on *Buffalo* creek, on southwest of *Buffalo* creek of good quality; not well watered, except in the southwest. Soil: generally first rate. Sub-soil: sand and gravel. Rock only on *Buffalo* creek, (specimen No. 3.) Fossils: (Nos. 28 and 51.)

Township 87.—Rolling prairie, except about ten acres of timber on 12; not well watered. Soil: second rate, black, sandy mould. Sub-soil: gravelly and rocky. The only rock observed is on the northeast of 12, (specimen No. 3.) Fossils (Nos. 28 and 29;) some loose pieces of iron ore, (No. 15,) and some boulders.

Township 88.—Rather more than half prairie; rolling in the southeast, flat in the west; the timber is chiefly on the *Makoqueta* river; on the west side there is but little good timber; on the east, on 23 and 24, some good oak, elm, and basswood timber; not generally well watered. Soil: on the flat prairie in the west, first rate; in the south and northeast, second rate. Cliffs of rock (specimen No. 3) frequently exposed in the timbered land along the *Makoqueta* river. Fossils (Nos. 29 and 89.)

Township 89.—Two-thirds high rolling praire; on 7, 9, 17, and 18, timber is second rate; the rest is all dwarf timber. Well watered in the west by the *Makoqueta* river and its branches. Soil: first rate on 16, 21, and 28, black sandy mould; the rest is second rate. Sub-soil: sand and gravel. Rock (No. 93.) Fossils (Nos. 29 and 54.)

Township 90.—Six-sevenths rolling prairie; one-seventh good white oak, walnut, and sugar maple timber. Pretty well watered by streams and springs. Soil: in the south some first rate soil; the rest second rate, dark, and sandy; in some parts flinty. Rock (No. 26.)

Township 91.—One-fourth rolling prairie; three-fourths a young growth of timber; American aspen, ash, sugar maple, and walnut, in the bottoms. Tolerably well watered by streams and springs. Soil: a black sand in the prairie; in the timber not quite so dark. Sub-soil: a yellow clay (in the timbered land.) Rock of the township (specimen No. 26.) Fossils (Nos. 29, 73, and 96.)

Township 92.—North half high rolling prairie, and broken; interspersed with a few groves of black and white oak. South half high, and very broken woodland; about one-half of the township has a growth of moderately good timber. Well watered by streams and springs. Soil: a dark clayey loam. Sub-soil: brownish clay. Rock of the township (specimens Nos. 26 and 3.) Fossil (No. 55.)

Township 93.—Nearly all rolling and broken prairie; a belt of timber on *Turkey* river, varying from a few rods to a mile in width: in all, about four sections of woodland in the township. Well watered. Soil: a dark clayey loam. Sub-soil: brownish clay. Rocks (Nos. 90, 91, 104, and 105.) Fossils (No. 106.) Some carbonate of zinc on the north of 13. In this township the blue limestone (specimen No. 91) is about one hundred feet above Turkey river.

Township 94.—All high rolling and broken prairie, except two sections of tolerable timber of black and white oak. Moderately well watered on the west and southeast by streams and springs. Soil: a third rate dark clayey loam. Sub-soil: brownish clay. Rocks (Nos. 26 and 103.) Fossils (Nos. 51, 52, 59, and 97.)

IN RANGE SIX WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 79.—Three-fourths broken prairie; one-fourth groves of timber, of oak, hickory, and basswood. Well watered by the *Iowa* river and good cold springs. Soil: in the southwest, where there are broken bluffs, third rate; the same in the northeast and northwest; in the southeast, where there is high rolling prairie, second rate. Rock of this township, a white compact limestone, containing a fossil called *stylina*, (see specimen No. 25;) the rock is hard enough to take a polish, and the imbedded fossil gives it a fine variegated appearance; the quarries, as far as they have been opened, do not afford slabs of sufficient size to make the rock very

valuable as a marble. In digging the wells at *Iowa* city, detached pieces of brown slate and coal have been struck; derived, doubtless, from the destruction of the lower beds of the coal formation at the margin of the coal field, which overlap the white limestone, (specimen No. 25.) It is not probable that any valuable seams of coal exist in this township. The light rock (No. 25) on 8, 9, 10, and 11, and all along the bluffs; at the depth of forty feet beneath the surface, it was struck at *Iowa* city; before reaching it, at a depth of between thirty and forty feet, pieces of timber resembling cedar were dug out. On the southeast of 10, is a chalybeate spring, and some little oxide of iron.

Township 86.—Three-fourths high rolling prairie; one-fourth timber and barrens; mostly a stunted growth of oak, hickory, basswood, and American aspen. Well watered. Soil: good second rate, black sandy mould. Sub-soil: generally sandy. On the southwest of 3, gray compact limestone and brecciated siliceous rock, including chert. Not much rock exposed.

Township 87.—All rolling prairie, except some dwarf timber in barrens along *Buffalo* creek. Not well watered, except in the southwest. Soil: second rate, black sandy mould. Sub-soil: gravelly. The only rocks visible are granite boulders, some from ten to fifteen feet high.

Township 88.—All high rolling prairie, with some wet spots. Not well watered. Soil: second rate, black sandy mould. Sub-soil: gravelly. A ledge of rock on 12, (specimen No. 3;) but very little rock to be seen, except boulders.

Township 89.—All high rolling prairie, except two groves of timber occupying from two to three sections; one grove, partly on 21, 22, 26, and 28, of basswood, and good white oak timber; the other, partly on 1, 2, and 12, of dwarf oak. Well watered, both by streams and springs. Soil: in the southwest, good second rate; in the southeast, wet, gravelly prairie; the rest, third rate, gravelly. Rock: a very crystalline limestone. Fossils (Nos. 54, 83, and 89.)

Township 90.—About one-third rolling prairie in the northeast; six or seven sections flat prairie in the southwest, with wet spots; in all, about one-half timber; along the *Makoqueta* river, and on 11, 14, 23, 26, 35, and 36, the timber is tolerably good; the rest is a stunted oak growth. Moderately well watered. Soil: in the prairie, second rate; in the bottoms of the *Makoqueta*, good second rate; in the barren, oak timber, poor sandy soil. Conspicuous cliffs of specimen No. 3. Fossils (Nos. 28 and 54.)

Township 91.—One-third, rolling prairie; two-thirds, a small growth of black oak; surface of timbered land very broken. Moderately well watered by streams and springs. Soil: third rate; black, but sandy, and full of flinty fragments. Sub-soil: in places, a yellowish clay. Cliffs of specimen No. 3. Fossils (Nos. 29, 92, and 95.)

Township 92.—North part, high, rolling, and broken prairie; south part, high rolling, and broken woodland—tolerably good white and black oak; about ten sections of woodland in this township. Very well watered by streams and springs. Soil: third rate dark clayey loam; darker in the woodland than in the prairie. Rock of the township (specimen No. 3.) Fossils (No. 29.)

IN RANGE SEVEN WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 88.—Mostly all high, rolling prairie. A belt of stunted timber along *Buffalo* creek; about one quarter of a section good timber on 34 and 35. Not well watered, except by *Buffalo* creek, and a few springs in the wet prairie. Soil: second rate; black sandy mould. Sub-soil: gravelly. No rocks visible, except granite boulders of immense size.

Township 89.—All high, rolling prairie. No timber of any value. Not very well watered. Soil: north half, second rate; south half, third rate—gravelly, but not quite so sandy as township 88. No rocks, but large boulders.

Township 90.—Principally prairie; on 13, 14, 24, and 25, some thin oak timber; a small grove of timber on 30. Well watered by streams and springs. Soil: generally poor third rate, with little flinty fragments disseminated; some on the west side second rate. Low down on the east fork of *Buffalo* creek, some rock (No. 3;) boulders of granite, gneiss, and porphyry, with pieces of chert on 19.

Township 91.—All prairie, except about one section and a half; rolling in the north and in the centre, level in the south. Some second rate timber, partly on 13, 24, and 25. Not well watered. Soil: sandy; first rate in the northeast; the rest second rate. Sub-soil: gravelly. No ledges of rocks discovered.

Township 92.—One-half broken prairie; one-half broken timbered land; timber, generally, a dwarf growth of black oak. Well watered, both by streams and springs. Soil: a light-colored mixture of sand and clay in the timber land; dark colored in the prairie; in the timber, third rate; in the prairie, second rate. Rock of the township (specimen No. 26, with specimens Nos. 31 and 68.)

IN RANGE EIGHT WEST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 90.—Mostly all high, rolling prairie; a little dwarf timber on *Buffalo* creek. Well watered by fine springs. Soil: in the west, good second rate; in the east, poor, gravelly third rate. No rock visible except boulders, which, on the west side, are large and numerous. On 20 a granite boulder was discovered, which measured eight feet high, thirty feet across, and ninety feet around. There are many others as large or larger in this township.

Township 91.—All prairie, two-thirds of which is low. No timber whatever. Tolerably well watered by the head waters of *Buffalo* creek and by springs. Soil: wet, coarse sand, black, but poor third rate; the poorest soil in these ranges of townships. Not a stake or mound showing corners in the whole township. Some granite boulders, but no ledges of rock.

Township 92.—All prairie, except about one section of timber in 1, 12, and 6, which is second rate; prairie, rolling in the north, flat in the south; very poorly watered. Soil: second rate; sandy, and sometimes gravelly. Sub-soil: gravel. On 12 and 13, ledges of specimen No. 3; no other rock visible, except a great many boulders, some of which are granite, others greenstone.

IN RANGE ONE EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—Mostly undulating prairie. Some stunted oak growth in the south. A grove of about two sections, partly in 7, 8, and 17, of oak

and hickory timber. Almost without streams. Soil: generally a deep, second rate sandy mould; on 4 and 5, some first rate upland; i extreme south, third rate. Sub-soil: on 35 (effervescent with acids) ...cating a sandy marl. In township 77, close by the south line of 78, limestone (specimen No. 14) containing fossils, (Nos. 56 and 57.)

Township 79.—All prairie. In the middle and north, low and wet; in the south, undulating. Watered only by *Mud* creek. A few wet spots. Soil: third rate. Sub-soil: clay. No rocks to be seen.

Township 80.—Mostly all broken prairie; two groves of timber, occupying about one section and a quarter. *Round* grove in the south, on 33; the other in the west, mostly on 14. The timber is chiefly oak, walnut, and hickory. Well watered by *Walnut* creek and by a branch of *Mud* creek; the *Wapsipinecon* river just touches the northeast corner. Soil: in *Walnut* grove, first rate; in the west, second rate, and sandy; in the south, third rate. Sub-soil: apparently sandy. Loose masses of chert and quartz scattered over the surface. On the northeast and northwest of 35, and northeast of 22, hydrated brown oxide of iron, in small quantities, intermixed with siliceous and calcareous fragments; on *Walnut* creek small masses of this iron ore, with detached masses of quartz (No. 74) and limestone, containing fossil (No. 66;) on 9, boulders of volcanic-looking rocks and crystallized quartz. Ledges of specimen No. 3 on northeast of 1.

Township 81.—In the centre, sandy, rolling prairie; in the north, low, flat prairie; northwest corner, broken prairie; groves of a light growth of oak timber—one on the southwest, occupying about three sections, on 30 and 31, and partly on 27, 28, 29, and 32. The land is here broken; a narrow belt of timber along the *Wapsipinecon* river, which flows through the east part of the township. Well watered. Soil: first rate on *Yankee* run; second rate in the northwest; low, wet, third rate, on the east side of the *Wapsipinecon* river; first rate upland near the south line; third rate in the grove on the southwest; second rate on the high ridges in the forks of *Yankee* run. Some ledges of siliceous limestone (specimen No. 3) on 35 and 36; detached masses of flint strewed over the surface.

Township 82.—Chiefly prairie; broken in the southwest, with swamps and sand ridges running between them; a narrow belt of timber along the *Wapsipinecon* river, and some thin timber, on the head of the creek, running through the eastern portion of the township. Not very well watered. Soil: generally third rate and sandy. Sub-soil: sand. On northeast of 13, rock (No. 3;) and on 28, rock (No. 12.) A ferruginous or chalybeate spring on southeast corner of 28.

Township 83.—All prairie, except a little scattering timber in the north; in the south, broken prairie—still more broken in the north; in the southeast, sandy ridges; the only timber is a little scattering dwarf oak, in the extreme north, on 1, 2, and north part of 10 and 11. Not well watered in the southwest and middle. Soil: third rate, black, and sandy. Sub-soil: in the east, clay, with which acids produce no effervescence; consequently containing no carbonate of lime. On the northeast and southeast of 3 and 10, low cliffs of rocks, (Nos. 3 and 12;) also, on 2, 15, and 17, same rock, with specimen No. 31 interspersed. Fossils, (Nos. 28, 29, 51, and 56.)

Township 84.—Two-thirds prairie; southern part very broken, with groves of good timber on *Bear* creek; sandy rolling prairie in the centre, partly on 9, 10, 14, 15, 16, 17, 21, 22, 23, 25, 26, 27, 34, 35, and 36, except a belt of timber on *Bear* creek; the timber, though not very large, is good.

Well watered. Soil: light and sandy; second rate in the northeast; all the rest third rate, except a strip through the centre, which is second rate. Rock of the township is specimen No. 3, containing fossil (No. 28) very often exposed—one of the upper members of the "cliff limestone." Diggings on the southwest of 15, but unimportant.

Township 85.—Only about three sections prairie; surface broken on 30, 31, and 32; high bluffs, especially in the northeast and southeast; all the rest very good timbered land, but surface broken. Very well watered. Soil: in the east and west third rate; along the centre a strip of about one mile and a half in breadth, second rate. Rock: in the east, like specimen No. 12; between 15 and 16, hydrated brown oxide of iron (specimen No. 15) in small masses; on southeast of 4 is found fossil (No. 29.) On the locality between 31 and 32, where the surveyors note on the map "appearances of lead ore," no discoveries of importance were made; specimen No. 31 is abundant, but that alone is very unsatisfactory evidence. It is not improbable that the deposites of iron, found ranging here from southeast to northwest, may originate in a vein, and be accompanied with a little lead ore, as is the case on *Mineral* creek, in township 85, range 1 west.

Township 86.—Only a neck of open prairie, partly on 3, 4, 9, and 10; the rest oak openings. Not well watered. Soil: sandy; third rate, except in the northeast, where it is second rate. Sub-soil: in the south, sandy. Rock, (No. 3,) with fossils, (Nos. 32, 51, 66, and 89;) on northwest of 29, some sandstone, fossil, (No. 54,) and quartz, (No. 74.) Small pieces of lead ore found on the southeast of 12, in red earth; no other indications of lead ore, except the existence of crystallized carbonate of lime. The same remark is applicable to the lead ore found in this township as that found in township 85. On the northwest of 30, rock full of fossil, (No. 66.)

Township 87.—Seven-eighths prairie; a few groves of second rate timber in the southeast of the township, and on 17 and 18. Tolerably well watered. Soil: good second rate sandy mould. The whole township covered with a kind of rocky fragment on the ridges. Rock, (No. 3 with No. 31 imbedded;) some iron ore (No. 15) in small fragments on the southeast of 11; also, some good specimens on southeast of 35, but no great quantity discovered. About forty shafts have been sunk on the northeast of 35, but no lead ore raised or discovered.

Township 88.—About one-third rolling prairie; two-thirds a thin growth of scattering white oak timber. Well watered by small streams and good springs. Soil: generally sandy; in the prairie, second rate. Cliffs of specimen No. 3, especially along the streams, containing fossils, (Nos. 28, 29, and 54;) some little iron ore (No. 15) on 13.

Township 89.—Very little prairie; mostly good timbered land, with a variety of timber; surface very much broken—hardly a place sufficient for a ten-acre field, unless in the extreme north. Well watered by streams and springs. Rocks: similar to specimens Nos. 3, 80, 84, 85, and 86. The diggings on 28 and 29 are old and abandoned; those in the northeast have been very productive; on 1 are very rich diggings; on 2, from 1,000 lbs. to 1,500 lbs. of ore have been raised in a day; on 12, adjoining *L. Langworthy's* diggings, from 60,000 lbs. to 70,000 lbs. of lead ore have been raised in a month; probably 1,000,000 lbs. have been raised in all. Northwest of 12 are *Hale's* diggings, where 250,000 lbs. have been raised; on every part of 12, lead ore has been raised; the diggings on south of 11

have been productive; the diggings in this township have been as productive as any in the Territory of Iowa, but they are not much worked at present.

Township 90.—About two sections of prairie in the northwest, on 5, 6, 7, and 8; the rest timbered land; in the northeast, land rolling, timber third rate; in the east, a tolerable good growth of black oak timber; in the south, broken timbered land. Exceedingly well watered by the *Little Makoqueta* river and its branches. Soil: third rate; generally sand, except near the south line. Cliffs of specimens Nos. 3 and 80. On southeast of 34, and southwest of 35, are the "*Durango*" diggings, where 700,000 lbs. of lead ore are said to have been raised; "*Timber*" diggings, on the south of 35, and also on 3, in township 89, (owned by Ewing & Carter,) where have been raised, in six months, 60,000 lbs. of lead ore; on the southwest of 33 a little ore has been raised. On the southeast of 15 are "Sherald's" diggings; 500,000 lbs. of lead ore are said to have been raised here in five years, by only working occasionally. Some small fragments of iron ore (No. 15) on southeast of 8.

Fractional township 91.—Little or no prairie; mostly high and timbered land; the growth is chiefly different varieties of oak. Well watered, except on 29, 30, 31, and 32. Soil: third rate; mixture of sand and clay; no bottom land of any consequence. Rock of this township: specimen No. 3, above; beneath, specimens Nos. 79, 90, and 91. No diggings on this fractional township; but it is within the boundaries of the lead region, and may probably afford lead ore.

IN RANGE TWO EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—Nearly the whole of this township gently rolling prairie, with some marshes. A grove of timber in the southeast, occupying about four sections. Not well watered. Soil: a dark sandy mould, second rate. Sub-soil: sandy. No rocks discovered, except boulders.

Township 79.—Mostly all rolling prairie; a marsh near the centre. A grove of hickory and oak, occupying about one section, a little northwest of the centre of the township, called "Hickory Grove." Not well watered. *Allen's creek* runs through the township. Soil: a second rate, dark, sandy mould, some of it slightly effervescent, showing an admixture of carbonate of lime. On southeast of 16, rock (No. 3.)

Township 80.—Chiefly gently rolling prairie. A grove of timber, called "Allen's Grove," a little southeast of the township, occupying about two and a half sections, of oak, ash, and hickory; and a belt of timber along the *Wapsipinecon* river. Moderately well watered. A bog in the southeast of the township. Soil: a second rate, dark, sandy mould, slightly effervescent, indicating an admixture of carbonate of lime. Sub-soil: sandy. On 1, 6, and southwest and northeast of 9, rocks (Nos. 3 and 9) apparently dipping slightly to the northeast.

Township 81.—All gently rolling prairie, with some wet spots in the east, north, and southwest. No timber. Not well watered. Soil: second rate sandy mould in the south; third rate in the north. No rocks exposed, except boulders in the northeast.

Township 82.—Mostly all prairie; south half, gently rolling prairie, with a few small sand hills, forty feet high, destitute of vegetation. No timber, except a little scattering oak growth in the extreme north. Not well water-

ed; no springs. Soil: poor, sandy, third rate. No rocks, except some large boulders in the northeast, running northeast and southwest, of granite and coarse conglomerate.

Township 83.—Mostly all prairie, similar to last township. No timber, except, in the south, a scattering oak growth. In the south, not well watered; in the north, some good springs and small streams. Soil: a third rate sandy mould; rather better in the north. No rocks in the south and middle of the township; rocky cliffs (of specimen No. 3) in the north.

Township 84.—In the south, about one-third broken prairie; well timbered north of the *Makoqueta* river, by sugar maple, walnut, and oak. Well watered by *Makoqueta* river and its branches. Soil: a deep sandy mould. Sub-soil: in some parts marly, in some parts sandy. Rock (No. 3) containing fossil (No. 28) exposed on all the watercourses; fossils (Nos. 54 and 73) are also found. Beautiful specimens of iron ore, called pipe ore (specimen No. 15) found on southeast of 25, and occasionally visible elsewhere. Rocks (Nos. 3 and 5.) On the northwest of 22, fossils (Nos. 29, 54, and 73;) on the northeast of 28, and northeast of 23, some iron ore. In the northwest of 6, *Burt's Cave*, where were found crystallized carbonate of lime and stalactites, (see specimen No. 36.)

Township 85.—North part broken prairie, with some scattering stunted oak growth; south part well timbered with white and black oak, basswood, sugar maple, and walnut. Well watered. Soil: on the ridges third rate; in the valleys a second rate deep mould. Sub-soil: northwest of 34 clayey or marly, generally clay. Rock (No. 3) containing fossil (No. 28) often exposed on the north fork of the *Makoqueta* river and its branches; in the north the rock contains No. 31, and sometimes specimen No. 74. On the southwest of 28, a fine spring discharges 5.25 cubic feet of water per minute, as determined by Owen P. Owens, sub-agent. Southeast of 33, iron ore (No. 15) in large quantities, in heavy timbered land, with good water power.

Township 86.—About six or eight sections of prairie; the rest thin openings, except in the northwest quarter of the township, where there is good white and Spanish oak, and hickory timber. Well watered by streams and springs. Soil: good second rate, but sandy, (no effervescence with acids, therefore no carbonate of lime.) Rock (No. 3.) Fossils (Nos. 29, 54, and 89.)

Township 87.—Two-thirds rolling prairie; one-third a thin growth of oak; one good small grove between 34 and 35. Well watered by *Lytle's* creek. Soil: second rate; more clay than in the preceding township. Sub-soil: on 18 a red clay. Rock of township (specimen No. 3) containing fossils (Nos. 29, 51, and 54.) No diggings; no indication of lead ore discovered. On southwest of 32, a little iron ore (No. 15.)

Township 88.—About eight sections tolerably level prairie in the south; the rest good timber and barrens; surface of land very rough and broken with high cliffs; well timbered along *Catfish* creek; the remainder chiefly barrens of dwarf oak growth. Well watered by streams and springs. Soil: in the south in the prairie, first rate black mould, the rest second rate; none as sandy as in township 86. Rocks (Nos. 3 and 68) with No. 31 frequently disseminated in it. Fossil (No. 54) on the northwest of 20; a little iron ore (No. 15.) The lower part of the *Catfish* diggings commence in the northwest part of this township; but few of those in the township are at present worked.

Fractional township 89.—High rolling prairie, with deep ravines, partic-

ularly in the north and south; all the timber that was in the township has been cut off. Tolerably well watered, except on 16, 17, 18, 19, and 20. Soil: second rate, rather sandy. Cliff rocks (Nos. 3 and 80) about three hundred feet high. The diggings in this township are more numerous than those in any other in the Dubuque district, *and have yielded, probably, more lead than all the rest of the Dubuque district put together. At Eagle point* the blue limestone first makes its appearance above the waters of the *Mississippi* river, containing all its characteristic fossils; (see specimens Nos. 52, 53, 56, 59, and 106.) Rock (No. 3) above contains Nos. 55, 60, and 67.

Fractional townships 90 *and* 91.—Between two and three sections of prairie; the rest is good timbered land. Tolerably well watered, except on the northwest. Soil: second rate and sandy, except where the rock (No. 82) comes near the surface; there the soil is clayey. Sub-soil: mostly clay. Bold cliffs of specimen No. 3 resting on specimens Nos. 82, 90, and 91. *Ewing's* diggings, on the southwest of 31, in township 90, have been very productive; it is said there has been more lead ore taken out of a given space here, than from any of the mines in the Dubuque district; the crevice or cave from which the ore was taken is, in places, thirty feet wide. These mines now afford little or no lead ore; carbonate of zinc having taken the place of lead ore in the "lode." *This will some day be a very important locality of carbonate of zinc.*

IN RANGE THREE EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Township 78.—Chiefly rolling prairie; about one-third oak openings. Not very well watered. Soil: first rate, dark, deep loam; in some places six feet deep. On the river, a very white limestone, in regular strata, is exposed, (specimens Nos. 22 and 25;) some of it brecciated, (made up of angular masses cemented together.)

Township 79.—All rolling prairie. No timber. Few streams or springs. Soil: second rate, dark mould. Sub-soil: underlaid by marl. No rocks to be seen.

Township 80.—Chiefly prairie. A few small groves of timber; *Long Grove*, in the south part of the township, and a few belts of timber on the *Wapsipinecon* river; in all, from two to three sections of timber. Not very well watered; low and marshy north of the *Wapsipinecon* river. On 5, a ledge of siliceous limestone, (specimen No. 3,) more regularly stratified than usual.

Township 81.—The whole of the middle and western part, high, rolling prairie, with sloughs running through it; about five sections of burr oak and hickory timber along *Silver* creek. Well watered in the east, but not well watered in the west part of the township. Soil: in the west, poor second rate, light colored, and sandy; in the valleys in the east, good second rate; on the ridges, light and sandy soil, with rock protruding in pavements and cliffs. Rock (No. 3) exposed on the east side, on 1, 2, 12, 15, 25, 26, and 35. In a well, on southwest of 1, rock (No. 3) was struck thirteen feet below the surface.

Township 82.—All high rolling prairie, except about one or two sections. A good grove of white, black, and burr oak, on the east half of 6; a thin stunted growth of timber on south side of northeast quarter of 9; a small grove on 16; the rest of the timber on the southeast of *Silver* creek, partly on 22, 26, 27, and 35. Well watered only in the neighborhood of

Silver creek. Soil: along *Silver* creek, first rate; on the hills, light and sandy, third rate. Sub-soil: a yellow loam. No rocks visible, except near *Silver* creek, on 35 and 36, (specimen No. 3.)

Township 83.—Mostly all prairie; in the southwest, high and rolling, with some thin openings; rich prairie bottom along *Deep* creek; in the northeast, high and rolling prairie; land rocky. No timber but a few thin openings. Pretty well watered by small streams and good springs. Soil: on the west of 6 and 7, good second rate; in the west, sandy; in the northeast, on the bluffs, very rocky. Numerous cliffs of rock (No. 3) containing fossil (No. 28.)

Township 84.—One-third prairie in the south; two-thirds timber along the *Makoqueta* river; surface of land very broken. Timber: white, black, and jack oak, and hickory. Well watered. Soil: on both sides of the river *Makoqueta*, sandy; in 2, 3, 4, 9, 10, and 11, some second rate; the rest third rate. Every quarter section in the east half abounds with rock (No. 3) containing fossil (No. 28;) not much rock in the west, except in 5 and 4; southwest of 12, some large masses of iron ore (No. 15;) also, on northeast of 3, north half of 1, east half of 4, northeast of 2, and southeast of 30.

Township 85.—Little or no open prairie; almost all timber; the east half well timbered; some good groves on the west half, but also a good deal of stunted timber. Well watered by *Farmer's* creek, *Brush* creek and its branches. Soil: second rate, but occasionally very rocky; specimen No. 3, containing specimen No. 28, is the rock of the township. Iron ore found in pieces scattered over the surface on 10, 11, 12, 33, 34, and 35, and on the southwest of 5 and northwest of 17; magnetic boulder on the southeast quarter of 33. On the northeast of 18, fossil (No. 54) was found.

Township 86.—Mostly all rolling and broken prairie; only a few spots of thin timber. Well watered on the west side by streams and springs. Soil: sandy and black in the narrow bottoms. Sub-soil: sandy. Rock of township, Nos. 3 and 68; fossils, Nos. 29 and 51. The greatest appearance of iron ore in this township is on 24, 25, 26, 35, and 36; the heaviest masses obtained in this township weighed about twenty pounds.

Township 87.—About one-third prairie; high, rolling prairie in the south and southwest; high broken ridges with rocky cliffs in the north, about four hundred feet above the *Mississippi* river; heavy timber on the face of the bluffs; the rest small oak timber. The north half well watered. Soil: in the bottoms, on the "*Tête des Morts*" creek, first rate, black and sandy; in the prairie, second rate, clayey; on the bluffs, third rate, containing numerous fragments of flint in it. Principal rock (No. 3 with No. 31;) on southwest of 18, rock (No. 5.) On northeast of 17, numerous sink holes, ranging east and west. Sink holes very common in the township; but no discoveries of lead ore. A number of specimens of iron ore (No. 15) on southwest of 34; and boulders (No. 74.)

Fractional township 88.—In the southwest some high, rolling prairie, with occasionally some low timber; the rest about three-fifths timber, rather indifferent; some good timber on 20; timbered land rolling, and surface often broken. Tolerably well watered by streams and by springs. Soil: generally poor third rate, sandy. Prevailing rocks (Nos. 3 and 68.) On southeast of 27 discovered fragments of lead ore; also, on northwest of 22, and southwest of 26. On the southeast of 15 are diggings, where about

5,000 lbs. of lead ore have been raised. Numerous loose fragments of iron ore (No. 15) were found on the bluffs northwest of 7, and on the southwest of 17.

Fractional township 89.—A small strip of prairie bottom along the river; small timber on the high bluffs. Soil: sandy, third rate. Rocks: No. 3, with No. 31 above; Nos. 90, 91, and 103, beneath. Fossils (Nos. 52, 53, 56, 59, and 66) at *Eagle* point, northwest of 7. There are diggings on the township line; fragments of lead ore were found on the declivity of the hills on northwest of 18.

IN RANGE FOUR EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Fractional township 78.—Chiefly high rolling prairie, with groves and oak openings. Timber occupies about one-third of this township. Two small streams run through the township. Soil: good second rate, dark and sandy, sometimes six feet deep. Rock: principally a siliceous carbonate of lime, (like specimen No. 3,) dipping, apparently, to northeast; also, on *Crow* creek, rocks, (Nos. 6, 7, and 8.) On the northeast of 27, on "Morse's" claim, is the only workable seam of coal in the *Dubuque district* yet discovered.

Township 79.—Prairie, with deep ravines running through it; often one hundred feet deep, by observation with the barometer, by *Dr. Locke*. Soil: second rate. Sub-soil: a sandy marl. Watered only by *Lost* creek and *Crow* creek. No timber. No rocks observed.

Township 80.—Chiefly rolling prairie in the south; flat prairie along the *Wapsipinecon* river, in the north. The only timber is about one section, partly on 17, 18, 19, and 20, and a little on the *Wapsipinecon* river. Soil: dark and rich, but too wet. Sub-soil: clay, along the river. No rocks visible, except on 1, near the river, (specimen No. 3,) and some on *Walnut* grove, (like specimen No. 3 and No. 7;) and on northeast of 7 was observed, dipping, apparently, to the north.

Township 81.—Slightly rolling prairie; very little timber; a small grove on 7, and one partly on 8, 9, 16, and 17, occupying, in all, nearly one section. The timber is oak, hickory, and some basswood; and on the *Wapsipinecon* river, the American aspen. Not well watered, except in the south. Soil: generally rather sandy; in the east, an admixture of lime. Principal rocks, (Nos. 3 and 24.) Several boulders scattered over the ground in the middle of the township, in low marshy ground.

Township 82.—In the west, rolling prairie; also, in the northwest; in the middle and northeast, stunted oak openings; in the southeast, rolling prairie, with swamps. All the timber is a small oak growth. Not well watered. Soil: a yellow sand, not effervescent with acids, therefore containing little or no carbonate of lime. Rocks in several of the bluffs similar to specimens Nos. 3 and 7.

Township 83.—Mostly all rolling prairie; some oak openings in the north, where the surface of the land is broken; a few groves of timber on portions of 15, 16, 21, and 22, mostly a fine growth of oak. Well watered in the south by *Deep* creek. Soil: generally third rate and rocky. Ledges of rock, particularly in the north, similar to specimens Nos. 3 and 7, containing fossils Nos. 28 and 73. On 15, a striped, yellow, siliceous-looking rock.

Township 84.—Rolling prairie, with openings in the south; the middle

and north are well timbered; surface of land broken in the north, and along the north side of Makoqueta river; about one-fourth prairie. Well watered. Soil: third rate, yellow and sandy. Rocky cliffs of specimen No. 3 all over the township, containing fossils, (Nos. 28 and 54.) Iron ore (No. 15) in several places in loose pieces, on the declivities of the hills, and some in crevices in the rock.

Township 85.—About one-fourth rolling prairie, and numerous perpendicular cliffs; about four sections of heavy timber, oak, basswood, and some walnut; the rest a stunted oak growth. Soil: second rate, sandy, and light. Sub-soil: sandy. Rock of the township, (Nos. 3 and 68;) fossil, (No. 29.) Some small fragments of iron ore, (No. 15,) but no important deposites of it discovered. No diggings or indications of lead ore.

Township 86.—The whole township very much cut up by rocky cliffs; about one-fourth high broken prairie, the rest either good white oak timber or oak openings; the best timber is on the slopes of the ridges. Very well watered, both by streams and springs. Soil: in the valleys, first rate black sandy mould; on the ridges, third rate. Sub-soil: in some places a ferruginous sand. Principal rock (Nos. 3 and 4) with calcareous incrustations, and imbedding No. 31. Fossils: No. 29 on section 27, No. 4 on 13, at the old diggings. Fragments of iron ore (No. 15) on southwest of 29 and southeast of 32; none larger than fifteen or twenty pounds observed. Some old abandoned diggings; no indications of lead ore.

IN RANGES FOUR AND FIVE EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Fractional townships 87.—Very little prairie, except on the Tête des Morts creek, of about three sections; the rest is a pretty good growth of oak. Well watered; some very fine springs. Soil: rather light colored, dry, and sandy, generally third rate; in some places second rate. Numerous high cliffs of specimen No. 3, imbedding specimen No. 68; numerous small fragments of iron ore (No. 15) on 25 and 26. Kelly's diggings are on the southwest corner of 5, (lately opened;) 1,000 lbs. of lead ore have been raised in all; on the southwest corner of northeast quarter of 4 are H. H. Gher's diggings, where about 15,000 lbs. are supposed to have been raised. Henry Potter's diggings on northwest of 5, (just opened,) in the ravines near the line between 25 and 35, fragments of lead ore were found on the surface. On the northwest of 4, Caleb Mallory has struck a lode, and has just commenced raising ore.

Fractional township 88.—On section 30, rolling prairie; on 31, 32, and 33, a stunted oak growth. Well watered by small streams. Soil: third rate, light colored, and sandy; surface of land broken. High cliffs on the river. No diggings in this fractional township, but there is reason to believe that lead ore may be found therein.

IN RANGE FIVE EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Fractional township 78.—Little or no open prairie; principally timbered with heavy white oak; surface rolling. Soil: second rate, dark mould. Sub-soil: sandy marl. Well watered by small streams and springs. A clay slate, (specimen No. 2,) with some carbonate of iron, on the northwest quarter of 9, on the Mississippi river. On southeast of 4, rock made up of grains of quartz, cemented by carbonate of lime, (speci-

men No. 1.) The last members of the coal measures, on the west side of the river Mississippi, are seen in this fractional township.

Fractional township 79.—Two-thirds broken prairie; one-third timber groves and openings interspersed through the prairie, chiefly on the east side, where the fractional township borders on the Mississippi river. Soil: dark, second rate. Sub-soil: a sandy marl. Three small streams water this fractional township. Rock of fractional township (specimens Nos. 3 and 4) dipping apparently to the northeast. The upper member of the cliff limestone (Nos. 3, 4, and 7) comes to the surface in this fractional township, from beneath the coal measures.

Fractional township 80.—Chiefly prairie in the southwest, on 31, 32, 33, and 34; level bottom land in the north and west; wet prairie in the southeast; only a few groves or thickets, and a strip of maple, walnut, and elm timber along the *Wapsipinecon* river. Well watered by the *Wapsipinecon* river and *Lost* creek, and several good springs along the bluffs. Soil: in the southwest very poor, also along the barrens sand bluffs; bottoms south of the *Wapsipinecon* river first rate; third rate in the north. None of the soil seemed to effervesce with acid, therefore indicating no admixture of carbonate of lime. Principal rocks, (Nos. 3, 7, and 10;) some loose masses of very siliceous crumbling sandstone.

Township 81.—All dry, rolling prairie; not half a section of timber in the township. No good streams. *Mud* creek waters it on the west, and forms a marsh about two miles wide. Soil: third rate, sandy mould; on southwest of 16, (specimen No. 3,) of a reddish color.

Township 82.—One-half prairie; high, rolling prairie in the east. The centre is an entire marsh about one mile wide. Pretty well watered by small branches. Soil: second rate, but rather sandy and light colored; does not effervesce with acids, showing it to be destitute of carbonate of lime. Rock (No. 3) of a reddish color.

Township 83.—Broken and barren prairie land; very little timber—not more than two or three sections. Well watered by *Deep* creek and *Simmon's* creek. Soil: poor, barren, except the small bottoms along the streams. High and very bluff, with cliffs of rock (No. 26) of a very rugged appearance. Fossil (No. 51.) On 27, a magnetic boulder, with polarity. Brown oxide of iron (some of it "pipe ore") on 27, scattered all over the surface. A cave in the southeast of 9.

Township 84.—About two-thirds prairie; in the centre and south, high rolling prairie; oak openings in the northwest and northeast; along *Deep* creek, some walnut timber. Very well watered—some very fine springs. Soil: along the streams, first rate; but the greater part is a poor soil. Sub-soil: an ochrey clay. Rock of the township, (No. 3,) containing fossil, (No. 73.) On 17 are some diggings for lead ore, where some six or eight pounds have been raised from a ferruginous clay. On 14 and 22, there are also some abandoned diggings. In some of these diggings, (viz: on southwest of 17,) a white rock was found, similar to that which, by disintegration, forms a white, plastic material, used in the manufacture of porcelain; it is a "*hydrate*" of "*silica*," containing a small per centage of "alumina," (softened white flint, or chert, combined with water and a little clay,) much the same sort of substance which has formed the white clay banks on the *Mississippi* river, below *Cape Girardeau*, in *Missouri*. This specimen is marked No. 27. Although several detached masses of it have been found,

no continuous stratum has been discovered, and it is not likely that large quantities of it will be found.

Fractional township 85.—About five sections of prairie, (chiefly rolling prairie ;) the rest of the township is tolerably well timbered, except on 33 and 34 ; the growth of timber is principally white, black, and burr oak. Well watered—a number of good springs. Soil: fine, sandy, light colored; in the centre and north, second rate ; in the south, third rate. Rock (No. 3) exposed in high cliffs. On northwest of 27, southwest of 28, and on 26, several large masses of iron ore (No. 15) were found. No discoveries or indications of lead ore.

Fractional township 86.—Not quite two sections of level prairie ; the rest tolerably good oak timber. Well watered by *Mill* creek and *Buck* creek ; some good springs of water. Soil: in the prairie, second rate, sandy, light colored. Sub-soil : clay. A fine light gray building stone on 18, high up on the bluff. No diggings or indications of lead ore.

IN RANGE SIX EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Fractional township 80.—Low, marshy land, cut up by bogs and sloughs. All bottom except the northwest corner, where there is a low ridge ; a narrow strip of timber along the river, of maple, shell-bark hickory, and hackberry. Well watered by the *Mississippi* river on the southeast. Soil : in bottoms, first rate, dark but wet, well adapted for grazing. On the ridge in the northwest, rock (No. 3) is exposed.

Fractional township 81.—High, flat prairie, interspersed with groves of timber ; about six or seven sections of white, black, and burr oak timber ; the timber lies in groves and strips along the streams. Well watered by *Mill* creek, and one or two other small streams. Soil: third rate on the prairie on which *Camanche* stands ; in the prairie in the west and in the north, second rate, generally light colored and sandy. No ledges of rocks observed; some boulders.

Fractional township 82.—But little open prairie ; chiefly a stunted oak growth ; oak openings on the bluffs and along the streams. Well watered, except on the northeast. Soil: light colored in the west ; in the east, reddish and gravelly. The whole township full of cliffs of rocks similar to specimens Nos. 3 and 5.

Township 83.—Broken prairie, except a small quantity of timber on the heads of *Elk* creek, in the northeast ; also, in the south, a little oak timber, where the creek goes out of the township. Well watered by *Elk* creek and its branches. Soil : in the south, second rate, and black ; in the north, third rate, and rather sandy. Rocky in the centre of the township: rocks similar to specimens Nos. 3 and 7. On 29 and 9, some iron ore in small detached masses strewed over the surface ; indications of bog iron ore on southwest of 34. There are some diggings on the northeast of 12, but no discoveries of lead ore made.

Township 84.—In the west, rolling prairie, and a stunted growth of oak ; the rest high, rolling prairie. The only timber is a scattering stunted oak growth in the west. Not well watered, except in the northeast. Soil: third rate, and rather sandy. In the northwest are high cliffs of rock, like specimens No. 3 ; a good deal of it has a reddish color ; on 5, 6, 7, and 8, in the ravines, are large quantities of brown hematite, (the purest kind of brown oxide of iron.) There are some abandoned diggings in this town-

ship, but no discoveries of lead ore of any value have been made. Cliffs of specimen No. 3, in the east, on 24, near the township line.

Fractional township 85.—Principally rough broken prairie, interspersed with a growth of stunted oak timber. Bluffs come nearly down to the river, except on 7 and 17. The face of the bluffs is rocky; rock like No. 7. Soil: similar to the foregoing township.

IN RANGE SEVEN EAST OF THE FIFTH PRINCIPAL MERIDIAN.

Fractional township 81.—Chiefly wet bottom, timbered with a low growth of cottonwood and burr oak. Well watered, Soil: black, wet alluvium (bottom.) In the northwest, rock like specimens Nos. 3 and 5, containing fossil (No. 66.)

Fractional township 82.—Low wet lands east of the bluffs, with ponds; destitute of timber; on the bluffs, high broken land, covered with a low growth of timber. Soil: along the river, rich, black, wet soil; on the bluffs, third rate, gravelly and sandy. Rocks like No. 3 on the bluffs, containing minute glistening siliceous particles.

Fractional township 83.—In the south, low prairie; in the north, rocky bluffs; very little bottom land along the bluffs; some stunted oaks. Well watered. Soil: in the south, wet; in the north, third rate. In the bluffs, rock like specimens Nos. 3 and 7, containing fossils (Nos. 54 and 73.)

Fractional township 84.—Between the bluffs and the river, the bottom land is without timber; a thin growth of oak on the bluffs. Well watered by springs at the base of the bluffs. Soil: first rate on 6 and 7; on the bluffs, third rate. In the bluffs, rock like No. 7.

Fractional township 85.—Contains but little more than a section; all rocky bluffs.

IN RANGE ONE WEST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—All prairie, except a small grove on 13, a thicket on 28 and 29, and a thicket on 8 and 9: this is the only timber in the township. Well watered in the west by streams and springs; not so well watered in the east. Soil: generally second rate, dark, sandy mould. Sub-soil: clay, with sand beneath. The prevailing rocks are similar to specimens Nos. 3 and 80; fossils (Nos. 56, 62, and 73.) On the east half of the township, about 75,000 lbs. of lead ore have been raised; on 12, are "Comstock's" diggings, where 40,000 lbs. of lead ore have been raised; the rest of the lodes on the east side of the township have not been very profitable. On the west side of the township, on 8, 9, and 10, are the "*Menomonie*" diggings, which have been very productive.

Township 2.—Southeast half, open, rolling prairie; northwest half, prairie, with a small stunted growth of oak; surface of land in the northwest rather broken, the rest high rolling ridges. Well watered in the west; not well watered in the east. Soil: second rate, dark mould, good farming land. Sub-soil: clayey. Prevailing rocks (Nos. 3 and 80;) fossils (Nos. 51 and 54.) On the southeast and southwest of 10, are the "Patch diggings," where about 2,000,000 lbs. of lead ore have been raised; the land is owned by J. Madden. There are numerous other diggings, but of minor importance. On the west side of the township but very little lead ore has been raised. There is every indication of the whole township being mineral lands.

Township 3.—One-third rolling prairie; the rest generally a thin stunted growth of timber, with a few good groves, well watered both by streams and springs. Soil: second rate, sandy mould. Sub-soil: clay. Prevailing rock like specimens Nos. 3 and 80. On the northeast of 9 are lead diggings, owned by Henry Snowden; the whole amount of lead ore raised is said to be 50,000 lbs.; two men raise at these diggings from 500 lbs. to 3,000 lbs. per day. There are diggings on almost every section in this township; the most important are on southeast of 10; two men can raise there 12,000 lbs. of lead ore in a week; on 14, 5,000,000 lbs. have been raised; on the line between 20 and 21 (Dr. Davis's diggings) 200,000 lbs. have been raised; from a new lode, 4,000 lbs. of ore have been raised at these diggings in a day by three men; on 28 and 29, there is an extensive lode not worked at present; on the southwest of 30, (on reserved land,) is a lode which yields both sulphuret of lead and sulphuret of zinc, (black-jack of the miner.) The diggings in this township generally go by the name of the "Plattsville diggings."

Township 4.—About three or four sections rolling prairie; on 1, 2, 3, 9, 10, 11, 15, 16, and 21, in the southwest, is heavy timber, consisting of oak, hickory, sugar maple, walnut, and basswood, and the land lies well for cultivation; in the southeast is second rate oak timber, except on *Platte* river; all the rest oak openings. Well watered, both by streams and springs. Soil: in the west and northeast, good second rate upland; in the southeast, third rate; generally a dark sandy mould. Sub-soil: a ferruginous clay. Prevailing rocks similar to specimens Nos. 80, 82, 98, and 102. The only diggings in this township which have yielded much lead ore are "Dr. Bassy's diggings;" he has raised about 1,200 lbs.

Township 5.—On the east side, rolling prairie, except part of 2, 3, 10, 15, 22, 26, 27, and 34, and a narrow skirt on a small stream in the southeast; the west side is timbered land; in the northwest, a light growth of white oak and a few pine trees on *Platte* river; in the middle and southwest, oak openings. Well watered by streams and springs. Soil: in the south, second rate sandy mould; in the north, third rate. Sub-soil: clayey. The rocks in the township belong to the blue limestone; overlying it is cliff limestone, and underlying it is sandstone, (see specimens Nos. 3, 80, 82, 98, and 103;) they are frequently exposed. There are diggings on 14, 15, 26, 27, 34, 35, and 36. 3,000 lbs. is said to be the most raised from any of these lodes.

Township 6.—About six sections of high rolling prairie on 36, and partly on 21, 22, 25, 26, 27, 28, 29, 30, and 35; the rest is thinly timbered with oak, except on 15, 16, 17, 20, and part of 21; and on the head of the west branch of *Blue* river, where the timber is rather better. Pretty well watered; one of the heads of the west branch of Blue river sinks and runs for a mile and a half under ground. Soil: in the prairie, a good second rate dark mould, with a mixture of sand and clay. Sub-soil: clay. Soil: in the north, third rate, surface broken; in the south, second rate, surface broken. Prevailing rocks (Nos. 3, 26, 80, 91, 103, 116, 125, and 126.) Some pieces of iron ore (No. 15) are scattered over the surface. No productive lodes of lead ore have yet been struck on the west side of the township. On 1 and 2 are diggings where from 4,000 lbs. to 10,000 lbs. of lead ore have been raised in a week; it is said that 2,000,000 lbs. have been raised from one lode in this neighborhood. "Parish's diggings," in this township, have not been very productive.

Township 7.—Surface of land very broken, and the whole covered with a small growth of stunted oak timber. Well watered by streams and springs, except on the ridges. Soil: generally third rate, sandy and gravelly, except on the ridges, where it is clayey. Rocks in this township are the upper sandstone, (No. 98,) and the underlying siliceous limestone, (Nos. 3', 26', and 116;) No. 98 in this township has frequently a green tint. Iron ore crystallized in "octahedrons," (8-sided,) and "icosahedrons," (20-sided,) (specimens No. 15,) is strewed in small pieces over the surface. In the southeast, on 36, some diggings have been made, but not much lead ore found. There is not much probability of finding any quantity of lead in this township, except in the south half, because the sandstone (No. 98) is too near the surface. Rock (No. 3') is generally destitute of fossils, but in this township a spiral univalve shell, and one or two other fossils, were found in it.

Fractional townships 8 *and* 9.—One-third level, dry, sandy prairie; high bluffs, with a growth of small oak bushes; some small groves of pine in the sand prairie; not well watered in the east. Soil: poor third rate, sandy and rocky. Ledges of rock (No. 8) resting on rock (No. 3') imbedding frequently specimen No. 116. Some little iron ore (No. 15) scattered over the surface. No diggings. No probability of discovering productive lodes of lead ore in this township.

IN RANGE TWO WEST OF FOURTH PRINCIPAL MERIDIAN.

Fractional township 1.—About one-third rolling prairie; the rest is chiefly a thin growth of stunted oak, except on the watercourses, where it is better timbered; tolerably well watered. Soil: generally a dark or reddish loam; in the west, second rate; in the east, good second rate. Prevailing rocks similar to specimens Nos. 3, 26, and 80. A little iron ore (No. 15) scattered on the ridges. The most extensive diggings are on the northwest of 12, owned by Kilborn. Since 1827, 1,300,000 lbs. of lead ore have been raised at these diggings; but they are not much worked at present. Some lead ore has also been raised on 2, but the diggings are not considered valuable. Although gravel mineral has been found in many places throughout this township, yet on the west side no lodes of lead ore have been struck.

Township 2.—About two sections of rolling prairie; the greater part of this township is pretty well timbered, especially in the ravines; very well watered by streams and springs. Soil: generally second rate, similar to township 1. Prevailing rocks, (Nos. 26, 80, 103, and 126.) The (so called) "Menomonie diggings" extend into the southeast of 35 and south half of 36; they are the most extensive diggings in the township; they were commenced in 1827. On the south half of 36, about 3,000,000 lbs. have been raised; and on the southeast of 35, 500,000 lbs. There are no other important diggings in this township. The diggings on southwest of 36 are on reserved land. On the northwest of 28, a minute vein of lead ore was found in a fragment of blue limestone.

Township 3.—No open prairie; a heavy growth of sugar maple, basswood, and on the west side oak. The timber in this township is as good, if not better, than any other in this range. Soil: a good second rate loam; surface of land in the west broken; in the east rolling. Sub-soil: a stiff clay; well watered, both by streams and springs. Prevailing rocks (No.

3, with Nos. 31 and 80;) fossil (No. 56.) On the north part of southwest quarter of 31 were found pieces of lead ore on the surface; gravel mineral was also found in several places on 31. Diggings have just been commenced on southwest of 32, and from 40,000 lbs. to 50,000 lbs. of lead ore already raised. On the southwest of 17 are diggings, but not much ore raised. A little lead ore has been raised on the northwest of 12. On the southwest of 32 is a good compact building stone, which will take a polish. The discoveries in this township are on entered land.

Township 4.—No prairie: well timbered by oak, sugar maple, basswood, and poplar. In the northwest corner are oak openings; well watered by streams and springs. Soil: in the south, clayey; in the north, rather more sandy, except on the west side of *Platte* river; generally second rate. Sub-soil: clay. Prevailing rocks (Nos. 3, 82, 91, and 102.) There are no important diggings in this township, but small pieces of lead ore have been found on 28, 32, and 33.

Township 5.—Not more than one-third open prairie; some cedar and pine on *Platte* river; the rest oak openings; well watered by streams and springs. Soil: in the east, third rate, sandy mould; in the west, some second rate. Sub-soil: in the west, clay. Prevailing rocks, (Nos. 3, 98, and 3'.) There are no lead diggings in this township; but the formation being the same as in other townships, where important discoveries have been made, the probabilities are that lodes of lead ore may yet be discovered.

Township 6.—About one-third rolling prairie; on the heads of *Blue* river and *Grant* river there is some good timber. Pretty well watered in the east. Soil: rather sandy, especially in the north—good second rate, except in the north. The prevailing rocks are No. 82, above; then Nos. 98, 3', and 98'. The only diggings are on south half of 22 and 23; but the lead ore was not found very abundantly. On the southwest of 29, considerable masses of iron ore (No. 15) were scattered over the surface. The quarter sections on which discoveries of lead ore have been made are entered. From the formation, it is probable that lead ore may be found on other parts of the township—at least in the south part.

Township 7.—No open prairie, except in the ravines; the timber is generally a stunted growth; surface of land broken; not well watered. Soil: third rate, sandy. Sub-soil: in some places rocky and gravelly, in some places clay. Prevailing rocks, (Nos. 3', 98', with Nos. 100 and 116.) The blue limestone and upper sandstone seem to have run out; and the siliceous limestone, lying between first and second sandstone, comes to the surface. No discoveries of lead ore have ever been made in this township; and from the change that has taken place in the rocks, it is not very probable that productive lodes will be struck. Iron ore (No. 15) in detached pieces found in several places.

Fractional townships 8 *and* 9.—Some low prairie on 9, 17, 18, and 19; a little pine on *Wisconsin* river; the rest, a growth of stunted oak. Soil: poor, sandy, third rate; surface broken. Sub-soil: generally gravelly; clay in some places,—in the bottoms sandy. Rocks (Nos. 3' and 98') below. No discoveries of lead ore or iron ore.

IN RANGE THREE WEST OF THE FOURTH PRINCIPAL MERIDIAN.

Fractional townships 1 *and* 2.—No prairie; tolerably good timber—principally white oak; pretty well watered, both by streams and springs. Soil:

second rate, dark, sandy mould. Sub-soil: clay. On 1 and 2 is situated Travers's "lode," which has been very productive of lead ore; no other diggings of importance. But since the true lead-bearing rock (marked No. 80) is here the prevailing formation, it is likely that other discoveries will be made in this township.

Township 3.—About three sections of rolling prairie on 1, 2, 11, 12, and 14; good timber on *Bois* creek, chiefly white and black oak; the rest thin white oak openings; tolerably well watered, both by streams and springs. Soil: in the prairie good second rate; the rest a poor second rate mould. Sub-soil: clay. Rocks, (Nos. 3, 82, and 80.) The diggings in this township are very numerous; the most important are on 34, 35, 36, 27, 23, and 24; these lodes are very profitable, and are known by the name of the "Snake Hollow diggings;" it is supposed that these diggings employ about four hundred miners.

Township 4.—Five or six sections of prairie, partly on 11, 12, 14, 22, 23, 26, 35, and 36; the rest is a thin growth of stunted oak timber, except on 29, 30, 31, 32, half of 19, and southwest part of 20, which is good white and black oak timber. Very well watered, both by streams and springs. Soil: in the prairie, first rate rich, black mould; in the timber land, second rate. Sub-soil: clay. Prevailing rocks (Nos. 3, 80, and 98.) On the southwest of 20 is Joseph Benner's diggings, where 224,000 lbs. of lead ore have been raised since the spring of 1839. On the northwest of 20 is Jesse Mullinx's diggings, where have been raised 700 lbs. or 800 lbs. of lead ore. These diggings are on the land entered by "Murray." The diggings in this township are called the "Pigeon diggings."

Township 5.—North half nearly all high rolling prairie; in the south, oak openings; tolerably well watered in the northwest. Soil: second rate, part sandy, part clayey. Sub-soil: generally clay. Rocks similar to specimens Nos. 80, 82, and 98; fossils (No. 59.) There have yet been no discoveries of lead ore in this township, but, from its geological formation, it is probable that lodes of lead ore may yet be struck in some part of the township.

Township 6.—One half poor, high rolling prairie in the south; the rest thin oak openings. Not very well watered. Soil: third rate. Sub-soil: clay. Prevailing rocks, (Nos. 103, 98, and 3'.) No discoveries of lead ore have yet been made in this township. The north part is not likely to afford productive lodes of lead ore, because the cliff limestone has run out; but in the south part lead may yet be discovered.

Fractional township 7.—The whole of this township is a thin growth of stunted white and black oak. Not well watered. Soil: third rate. Sub-soil: sandy. Prevailing rock (Nos. 98 and 3'.) The blue limestone is only visible in the south part of the township. On 7, 8, and 18, near the *Wisconsin* river, is a good deal of iron ore (No. 15) strewed in loose masses on the surface. There is very little probability of this township affording lead mineral; the true lead-bearing rock is not to be seen. The stratum marked No. 3' may possibly afford lodes of lead ore, but no valuable discoveries have yet been made in this rock.

Fractional township 8.—Some prairie bottom on 24, 25, 33, and 34; some pine trees on the *Wisconsin* river; the rest a thin growth of stunted oak. Well watered. Soil: poor, sandy, third rate. Sub-soil: gravel. Prevailing rocks (Nos. 3', and 98'.) No. 98' is exposed about fifteen feet above the waters of the *Wisconsin* river; it is here a brown sandstone.

Rock No. 3' is about thirty or forty feet thick, and No. 98 eighteen feet thick; this formation extends nearly to the ridge on which the "military road" runs. No indication of lead ore.

IN RANGE FOUR WEST OF THE FOURTH PRINCIPAL MERIDIAN.

Fractional townships 2 and 3.—About one-third broken prairie; on the east side a good growth of oak and sugar maple timber; in the middle the timber is of a thinner growth. Very well watered by streams and springs. Soil: second rate, clayey. Sub-soil, clay. Specimen No. 3 is the prevailing rock. Specimens Nos. 98 and 103 occasionally visible. On the northwest of 20, some "gravel mineral" (fragments of lead ore) was discovered. There are no diggings in this township, but there is reason to believe that discoveries of lead ore will be made. Some iron ore (No. 15) was found scattered on the surface, but no body of it discovered.

Township 4.—In the northwest, six sections of rolling or broken prairie; some oak openings north of *Pigeon* creek; good timber south of *Pigeon* creek; the rest is a tolerable growth of oak timber. Very well watered by streams and springs. Soil: second rate, sandy mould. Sub-soil, clay. Prevailing rocks (Nos. 82, 91, 98, and 80.) On the northeast of 22, and southwest half of northwest quarter of 13, was found some "gravel mineral," (pieces of lead ore.) In this township, on the southeast of 15, (on land entered by Murray, are "Day's diggings," where 500,000 pounds of lead ore have been raised. On the northwest of 17 are "Jos. McDonald's diggings," where 40,000 pounds have been raised. On the south of 20 are "Arthur's diggings," where 62,000 pounds have been raised; and on 28 and 29 are the "Beetown diggings," where from 2,000,000 pounds to 3,000,000 pounds have been raised.

Township 5.—Mostly all prairie, or at least *very thinly* timbered by a small stunted growth. Tolerably well watered, both by streams and springs. Soil: poor, sandy, third rate. Sub-soil: clay. Prevailing rocks (Nos. 91, 98, and 105.) No diggings in this township, but it is possible that discoveries of lead ore may hereafter by made.

Township 6.—South half, all rolling prairie; north half, a thin growth of stunted oak, with some oak openings. Tolerably well watered. Soil: second rate, clayey; in some places rather sandy. Sub-soil: clay. No diggings in this township; the south half is included in the mineral tract. Prevailing rocks, (Nos. 82, 103, 98, and 3'.) Considerable iron ore (No. 15) in loose pieces found on the surface.

Fractional township 7.—Little or no open prairie; very thinly timbered with a growth of stunted oak. Tolerably well watered by streams and springs. Soil: poor, thin, and sandy; land high, and surface very much broken. Sub-soil: sandy. Prevailing rocks, (Nos. 82, 103, and 106.) Fossils (Nos. 52 and 56.) On the northeast of 28 are some diggings where a little "gravel mineral" was found, but no body of lead ore has been discovered.

IN RANGE FIVE WEST OF THE FOURTH PRINCIPAL MERIDIAN.

Fractional township 3.—Chiefly prairie, with small groves of timber; some good timber for two miles on the creek, in the west; tolerably well watered in the west. Soil: good second rate, rather clayey; land lies

well for cultivation. Sub-soil : clay. Prevailing rocks, (Nos. 3, 26, 126, and 80.) Iron ore (No. 15) found occasionally in small pieces on the surface. There are some diggings in the township where lead ore has been raised, but none are worked at present. The geological formation is similar to that of the best mineral land.

Township 4.—Nearly all prairie; surface rolling; a few clumps of stunted timber; a few pine trees on *Rattlesnake* creek. Soil: second rate, dark, clayey. Sub soil: clay. Prevailing rocks (Nos. 3 and 80.) On the southwest of 29 are "Patch diggings," where 200,000 lbs. of lead ore have been raised. Loose peices of iron ore (No. 15) are abundant on several sections. The surface appearances all over the township indicate lead mineral.

Township 5 —Nearly all prairie; a few small groves of timber in the west; some tolerable timber on the heads of *Sand* creek. Well watered on the west side. Soil: good second rate, clayey. Sub-soil: clay. Prevailing rocks (Nos. 126, 91, and 98.) No important diggings in this township. On the southwest of 14, a little lead ore has been found. The surface indications in many places indicate mineral land. On the ridges, and on 15 and 23, and other places, were found numerous fragments of iron ore, (No. 15.)

Fractional township 6.—Nearly one-half broken prairie; one-half a growth of stunted oak openings. Very well watered by streams and springs. Soil: generally second rate, but surface of land broken. Sub-soil: clay. Prevailing rocks (Nos. 3' and 98.) On the southeast of 19 are some diggings, but no discoveries of any value have been made; nor is it likely that any valuable lodes of lead ore will be struck in this township.

Fractional township 7.—No open prairie; surface of land very broken; a thin growth of stunted timber. Well watered. Soil: poor, except in the small bottoms, clay. Sub-soil: clay. Prevailing rocks (Nos. 3', 98', 98, and 82.) No discoveries of lead ore.

IN RANGE SIX WEST OF THE FOURTH PRINCIPAL MERIDIAN.

Fractional township 3.—Prairie and timber, but surface of land so broken that it is hardly fit for cultivation. Well watered. Soil: third rate, claycy. Prevailing rocks (Nos. 3 and 126.) No important discoveries of lead ore, but there are surface indications of mineral. Iron ore, (No. 15,) in loose fragments, abundant.

Fractional township 4.—All prairie, except a strip of stunted oak timber on the river and on the creek. Tolerably well watered. Soil: good second rate, clayey. Sub-soil: clay. Rock of the township (No. 3) There are no diggings in this township; but the surface indications are similar to those on the mineral lands.

IN RANGES SIX AND SEVEN WEST.

Fractional townships 5.—Chiefly a thin growth of stunted oak timber. Well watered by streams and springs. Soil: second rate, dark, clayey; surface of land broken, particularly on the west side. Prevailing rocks (Nos. 91 and 118) above, and (No. 3') below. Fossil, (in No. 91, No. 56.) No diggings. The northwest half of these townships is not likely to afford valuable deposites of lead ore, as the blue limestone formation and underlying sandstone are too high in the ridges.

IN RANGES SIX AND SEVEN WEST OF FOURTH PRINCIPAL MERIDIAN.

Fractional townships 6.—No open prairie; chiefly oak openings; some little good timber, but most of it is of a stunted growth. Well watered by streams and springs. Soil: rather light colored and clayey, second rate. Sub-soil: clay. Rocks (Nos. 91, 103, 126, 102, 98, and 3'.) No diggings. No indications of valuable deposites of lead ore.

IN RANGE ONE EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—Mostly all broken prairie; in the northeast a few stunted white and black oak trees; tolerably well watered by streams and springs. Soil: a second rate sandy mould. Sub-soil: a yellow clay. Prevailing rocks (Nos. 3 and 80.) Nearly the whole of this township is riddled with mining pits, and several very valuable lodes of lead ore have been struck; the most important are—

The "New diggings," on 25, 26, and 27;

The "Hardscrabble diggings," on 19 and 30;

The "Bull branch diggings," on 29, 30, 31, and 32;

The "Raccoon branch diggings," on 7, 8, 17, 21, 28; on 28 are the principal diggings.

At the "New diggings" as much as 5,000 lbs. of lead ore have been raised by two men in one day. On 28 and 17, from 4,000 lbs. to 10,000 lbs. of lead ore have been raised by two men in one day, (some years since.) On 28, at "Shaw and Gennett's" diggings, from 10,000 lbs. to 15,000 lbs. have been raised in one day by two men. On the northwest of 28, 10,000,000 lbs. of lead ore have been taken from one lode extending hardly across the quarter section. On the southeast of 28 is a very valuable lode; but it is not worked at present, because an injunction has been laid upon it.

On the northeast of 21, two men can raise 3,000 lbs. per day;

On the southeast of 32, two men can raise 3,000 lbs. per day;

On the northeast of 31, two men can raise 3,000 lbs. per day; and last season 16,000 lbs. of lead ore were raised by two men in one day.

On the southwest of 32 the uppermost excavation has yielded 1,000,000 lbs. of lead ore; this excavation is worked one hundred and fifty yards into the side of the hill, and the ore wheeled out in the manner in which coal is procured from the most accessible beds. On the southeast corner of the northeast quarter of 31, on the "*Bull*" branch of *Fever* river, several large pieces of lead ore were picked up on the ground, where no diggings at present exist. From the mines on the "Bull" branch two men can raise 3,000 lbs. per day. There are seven furnaces for smelting the ore in this township. Along with the lead ore, some peices of copper ore, (No. 110,) and carbonate of zinc (No. 123) ore, have also been found on the southwest of 21. Beautiful specimens of sulphuret of iron, crystallized, (No. 48,) have been found at these mines. Rock (No. 80) is very prevalent throughout this township.

Township 2.—Two-thirds high rolling prairie in the northeast and southwest; *Elk* grove runs diagonally from northeast to southwest, about one mile wide; the timber is a variety of oak; tolerably well watered by streams and springs. Soil: second rate—a mixture of sand and clay. Sub-soil: generally a yellow clay; masses of chert (No. 68) often disseminated. Rocks (Nos. 3, 80, and 82.) There are no very important diggings in this township; but there is every reason to believe that it is rich in mineral.

Township 3.—The greater part of this township is rolling prairie; about three sections (*Elk* grove) of tolerable timber on 28, 32, and 33, and about one-fourth section on 10; not very well watered. Soil: a second rate sandy mould—fine farming land. Prevailing rocks (Nos. 3 and 80.) The best diggings are "Phillips's diggings" on southeast of 20, (just commenced;) "Dunn's," on southeast of 29; and "David Sailey's," on southeast of 34 and southwest of 25; two men raised at these diggings (at a time when they yielded most) about 3,000 lbs. of lead ore per day. The surface indications are the same as the richest mineral land.

Towhship 4.—The northwest and middle part undulating prairie; the southeast well timbered with oak, basswood, and walnut; in the northeast, a thin growth of stunted oak. All, except the northeast, is rolling—there the surface is broken. Very well watered both by streams and springs. Soil: a rich sandy mould. Sub-soil: clay; beneath which the miners generally reach sand. Prevailing rocks (Nos. 3 and 80.) In the north rocks (Nos. 82, 102, 90, and 98) are exposed. On the top of the west *Platte* mound were found fossils, (Nos. 28, 29, 51, and 54.) On 17 and 18 is a lode of lead ore which has yielded considerable, but it is not worked at present. There are other diggings in this township, but no miners were found at work in them; they are called "old diggings."

Township 5.—Mostly rolling prairie; a few stunted white oak trees in the south; one good grove on the southeast of 26; tolerably well watered. Soil: second rate; in some places sandy, in some places clay. Prevailing rocks (Nos. 3 and 80;) also (No. 31) crystallized carbonate of lime very abundant and pure on southwest of 13; a little lead ore was found here also. The "Peccatonnica diggings" are in this township; on the best lode on 3, two men can raise about 3,000 lbs. in a day. Sandstone (No. 98) is to be seen, now and then, in the lower part of the bluffs.

Township 6.—About one-half rolling prairie; the rest openings of burr and white oak; tolerably well watered by streams and springs. Soil: in the prairie, first rate upland; in the timber, second rate, and surface of land broken; clay appears to predominate in the earthy ingredients. Prevailing rocks (Nos. 126, 90, 91, 102, and 98.) The principal diggings in this township are the "Centreville diggings," on 5, 6, 7, and 8. At these diggings, sulphuret of zinc, carbonate of zinc, sulphuret of iron, and sulphuret and carbonate of copper, (Nos. 122, 123, 48, and 110,) have been found. (See township map.) All the important diggings noted on the map.

Township 7.—The greatest part of this township is broken land, with a very thin growth of stunted burr oak; there are only about four or five sections of open rolling prairie. Not very well watered. Soil: in the prairie, good second rate; in the east, rather sandy; in the west and middle, clayey. Sub-soil: an ochrey clay. Prevailing rocks (Nos. 126, 80, 91, and 103.) The diggings in this township are known by the name of the "Blue river diggings;" the most important are on northwest of 28, ("Jones's diggings,") where from 10,000 to 20,000 lbs. of lead ore have been raised from one lode in a month: here large quantities of carbonate of zinc (No. 123) have also been found associated with the lead ore.

Fractional townships 8 *and* 9.—The whole of fractional township 9 is a swamp: the greatest part of fractional township 8 has a thin growth of stunted burr oak timber; in the south the timber is rather better; the surface is generally very broken; there is some level prairie (part of "English prairie") on section 6. Not very well watered. Soil: on the hills, poor

third rate; in the lower part of the prairie, pure sand; in the south, the soil is rather better. Rock: a coarse siliceous sandstone (No. 101 or No. 98.) No diggings, and no discoveries or indications of lead ore. Considerable iron ore (No. 15) scattered over the surface.

IN RANGE TWO EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—About three-fourths prairie and cleared land; about one-fourth oak openings and groves; *Gratiot's* grove appears to be the best. Very well watered by small streams. Soil: a very dark, rich mould. Sub-soil: clay. Prevailing rocks (Nos. 80 and 3.) The "White Oak Spring diggings" are partly in this township, on the southeast of 32 and southwest of 33; in eighteen months, in the years 1836 and 1837, $56,000 worth of lead ore was raised at these diggings; $30,000 worth has been raised here since that time; the shaft is now sunk down to the water; most of the lodes run east and west. On the northwest of 1, from 50,000 to 60,000 lbs. of lead ore have been raised. The diggings on 2 are not worked at present, but "mineral" has been raised here to the amount of $50,000 in value. The "new diggings" extend into 30 of this township; they have been valued at $50,000. On the southwest of 11 are extensive diggings; but they are at present abandoned, as the excavations have reached the water: these are the principal diggings, and they are generally upon entered land.

Township 2.—All prairie, except about three sections of timber on 30, 31, 32, and part of 33, of young white oak; not well watered; a few springs; a good deal of stagnant water. Soil; a second rate sandy mould. Sub-soil: clay. No rocks visible; some loose masses of chert (No. 68) scattered on the surface. The "Stump Grove diggings" extend into 36. No important discoveries have been made in this township.

Township 3.—About one-third prairie, with low flinty ridges; two thirds oak openings; tolerably well watered; the southern sections, and also in the southwest, are first rate rolling prairie land; the oak openings are generally of second quality. Soil: in the prairie rather sandy; in the timbered land more clayey. Sub-soil: sand and clay. Prevailing rocks (Nos. 3 and 80.) Near the south line of the township are some diggings; some lead ore has been procured in some of the southern sections, but no valuable discoveries of lead ore have yet been made in this township.

Township 4.—About one-fourth broken prairie in the middle and southwest; the rest is principally a thin and stunted growth of timber; there are two good groves of timber, one on 10 and 11, and the other on 20, 28, and 29; well watered by streams and springs. Soil: a dark, rich mould. Sub-soil: where visible, a yellow clay. Rock (No. 3.) On the southeast of 16 are some diggings, but they appeared to be abandoned.

Township 5.—About half rolling prairie; good timber in the southeast, chiefly white oak; well watered by streams and springs. Soil: poor, clayey, second rate; surface broken. Sub-soil: clay. Rocks (Nos. 3 and 80.) Fossils (No. 51.) The most important diggings in this township are on 8; they extend east and west for about half a mile, and are called the "*Pedlar's* creek diggings." The amount of ore raised could not be ascertained. There are several other diggings, of less importance, that are noted on the township map.

Township 6.—Rather more than one-third good rolling prairie in the

south, the rest oak openings; third rate in the north and west; second rate on 11, 12, 13, 14, north half of 23, and 24. Well watered by streams and springs. Soil: upland in the prairie, first rate; in the timbered land, second rate. Sub-soil: in the north, sand and clay; in the south, clay. Prevailing rocks: Nos. 126, 102, 103, 120, and 98. Fossils: Nos. 51 and 56. Most of the diggings are in the south part of the township, but none of them have been very productive. Small pieces of iron ore (No. 15) were found in some places scattered over the surface.

Township 7.—No prairie; openings of burr, white, and black oak; surface broken. Well watered by streams and springs. Soil: second rate, a mixture of sand and clay. Sub-soil: rather sandy. Prevailing rocks: Nos. 98, 3', 111, and 113. No fossils. No diggings, nor indications of productive lodes of lead ore.

Fractional township 8.—No open prairie; some good bottom land on *Wisconsin* river, on 4, 5, 6, 9, and 10, and on *Otter* creek, on 25, 35, southeast of 26, northwest of 36, and south part of 24; the rest is thin oak openings. Very well watered. Soil: same as in township 7. Prevailing rocks: Nos. 3' and 98', imbedding Nos. 74 and 68. Loose fragments of iron ore, (No. 15,) in places, are strewed on the surface; No. 98' is often cemented by iron. No diggings. No discoveries of lead ore.

IN RANGE THREE EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—The greatest part of the township is high rolling prairie; some tolerable oak timber on 29, 30, 31, and 32, and a few stunted oaks on 12, 13, and 14, on *Wolf* creek. Well watered in the east and southwest by streams and springs. Soil: a second rate loam. Sub-soil: sand and clay. Prevailing rocks: Nos. 3 and 90. On northwest of 28, in a ravine, found some "gravel mineral," (fragments of lead ore.) No important diggings in this township. Loose fragments of iron ore (No. 15) strewed, in places, on the surface.

Township 2.—About one-half rolling prairie; some narrow, flat prairie along *Little Otter* creek, and about one section of good bottom land on *Peccatonnica* river; nearly one-half oak timber, of a thin and stunted growth: no good timber. Tolerably well watered by streams and springs. Soil: a rich, black, upland mould, first rate. Sub-soil: clayey. The "Stump Grove diggings" are partly in this township, in northwest of 31. The lead ore is associated here with "sulphate of barytes," (No. 131;) this is one of the rare instances of finding "sulphate of barytes" in Wisconsin, although it is so universally found in Missouri, along with lead ore. There are some diggings on 4, but they appear to be abandoned. Prevailing rocks: Nos. 3 and 80, imbedding No. 68.

Township 3.—Only about one section of open prairie; the greatest part of the township is oak openings; on 14, 15, 22, west half of 23, 25, 26, 36, 34, and 13, are about four sections of good red and white oak timber. Well watered, both by streams and springs. Soil: in the prairie, first rate; in the oak openings, second rate. Prevailing rocks: Nos. 3, 80, and 120. Fossils: Nos. 59 and 73. Some masses of iron ore (No. 15) scattered on the surface, particularly on northeast of 19. There are no diggings in this township at present, though there is every reason to believe that lead ore may be found.

Township 4.—Mostly all prairie, or cleared land. About four sections

of third rate timber in the south, on 27, 28, 33, and 34; and on the west side of the township some oak openings. Tolerably well watered by streams and springs. Soil: first rate upland; some good bottom land on *Big Otter* creek. Sub-soil: clay. Rocks: Nos. 3, 80, 126, 102, and 98. The most extensive diggings are "Grey's" and "McKnight's," on 5. "Ansley's" copper diggings extend into this section. The whole surface, in the northwest part of this township, is riddled with mining pits; and the lodes which have been discovered are very accessible, and have been very productive.

Township 5.—Eight or nine sections of rolling prairie, running through the middle of the township; the rest is a very stunted and straggling growth, particularly on the west side of the township. Well watered by streams and springs. Soil: in the prairie, first rate; in the timber, second rate; sometimes sandy, sometimes clayey. Sub-soil: generally a ferruginous clay. Prevailing rocks: Nos. 3, 80, 90, 91, 98, and 120. The diggings in this township are very numerous, and the ore for the most part easily procured. The most extensive diggings are on 29 and 32, northeast from Mineral Point. The greatest part of the copper ore which has been raised in Wisconsin has been procured on these sections. Both the sulphuret and carbonate of zinc have been found at the diggings around "Mineral Point." Small pieces of iron ore (No. 15) were also found at several places in this township.

Township 6.—About one-third rolling prairie, the rest oak openings; well watered by springs. Soil: in the timber, second rate: in the prairie, first rate upland. Prevailing rocks, (Nos. 3, 80, 26, and 98.) Numerous diggings in the prairie; the most extensive are in the vicinity and north of Dodgeville. On the southwest of 27, 30,000 lbs. of lead ore have been raised per month. The lodes run both east and west, and north and south. Several very productive north and south lodes have been worked at these diggings. At the Dodgeville diggings, several lodes (not the very best) have yielded, within a distance of four hundred yards, from 1,000,000 lbs. to 5,000,000 lbs. of lead ore. The mines here have not been worked below eighty feet.

Township 7.—About two sections of prairie on 28, 29, and 33, and a little on 20; on the knobs on 35 and 36 are a few pine trees; the township is mostly covered with oak openings; well watered, both by streams and springs. Soil: generally a third rate sandy mould. Sub-soil: sandy or gravel, with fragments of chert (No. 68.) Prevailing rocks, (Nos. 98, 3', 118, and 98'; imbedded in rock No. 3' are specimens Nos. 116, 74, and 68. There are no diggings, except some old diggings on the northwest of 20. On the southwest of 16 several large pieces of lead ore were found during the examination of this township, and some small pieces on the southwest of 29; but, from the rock formation of this township, it is not probable that extensive lodes of lead ore will be struck. Loose masses of iron ore (No. 15) strewed on the surface.

Fractional township 8.—No prairie of any value; mostly burr and white oak openings; surface of land very broken; the only good timber is some between 25 and 26; well watered. Soil: a mixture of sand and clay, second rate. Sub-soil: pure sand. Rocks, (Nos. 102, 98', and 3'. No diggings: no discoveries of lead ore; little of iron ore (No. 15) occasionally found.

IN RANGE FOUR EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—The south half, high rolling prairie; in some places surface broken. The north half is a stunted growth of oak, except in the west half of 1 and northwest of 12, where there is a good growth of sugar maple and walnut timber. Well watered by streams and springs. Soil: in the prairie, good second rate; on the low ridges, rather rocky; in the timber, on 1 and 12, rich bottom land. Sub-soil: for the most part clayey; in some places sand and clay. Prevailing rocks, (Nos. 3 and 90.) No diggings in this township, though the surface indications denote mineral. Some fragments of iron ore (No. 15) scattered on the surface.

Township 2.—About four sections of prairie, surface high and rolling; the timber is chiefly oak openings; on 16, 25, and northwest of 6, is some good timber. Well watered by fine springs and streams. Soil: upland prairie second rate; in the east a first rate loam; in the west an admixture of sand. Sub-soil: clay. Prevailing rocks, (Nos. 3 and 90.) Fossils, (No. 73.) In the west and northwest of the township, numerous fragments of iron ore (No. 15) were found. On the northwest of 12 are Whiteside's diggings, where a great quantity of lead ore was raised some years since; on the northeast of 10 and northwest of 11 are some old diggings; on the south of 13 and north of 24, and in the adjoining township, are Hamilton's diggings, which are very extensive; on four acres of ground at these diggings from 2,500,000 lbs. to 3,000,000 lbs. of lead ore were raised before the miners were incommoded by water. A steam engine has lately been erected here, to drain the mines; a shaft is here sunk to the depth of sixty-five feet, and lodes are here generally worked to the depth of twenty to thirty feet before the miner is incommoded by water. This is the only instance (in the Territories) of the mines being drained by means of steam power. Some little carbonate of zinc (No. 123) is found at these diggings.

Township 3.—About one-eighth high, rolling prairie; in the northeast and west, oak openings; in the southwest, some tolerable good timber. Well watered by streams and springs. Soil: in the upland, first rate; in the timbered land, good second rate, black loam. Sub-soil: clay, with fragments of rock. Prevailing rocks, (Nos. 3 and 80.) Fossil, (No. 73.) The only diggings where lead ore has been discovered are on southeast of 17, though the surface indications denote "mineral." Iron ore (No. 15) in loose fragments occurs occasionally in this township.

Township 4.—One-third high, rolling prairie; two-thirds oak openings. Well watered both by streams and springs. Soil: a dark loam, with fragments of chert, (No. 68.) Sub-soil: clay. Prevailing rocks, (Nos. 3, 129, and 98.) The diggings in this township are on the northeast of 23, (just commenced,) on the northwest of 20, and northeast of 19, where 10,000 lbs. of lead ore have been raised; on the northwest of 31 are old diggings. The cliff limestone affords in this township a good building rock. Small fragments of iron ore (No. 15) found in several places in this township.

Township 5.—About one-fifth rolling prairie, in the southern sections; a little wet prairie on *Dodge's* branch; nearly four-fifths oak openings. Well watered by streams and springs. Soil: generally third rate; in the prairie, second rate, black mould; in some places a yellow loam. Sub-soil: clay, with fragments of flint. Prevailing rocks, (Nos. 102 and 98.)

No discoveries of lead ore of any importance have yet been made in this township. Pieces of crystallized iron ore (No. 15) scattered all over the township.

Township 6.—The south half, rolling prairie; north half, oak openings; surface broken; on the knobs on *Pine* creek and its branches are some small pine trees. Well watered by streams and springs. Soil: in the prairie, second rate; the rest poor, thin, third rate, a mixture of sand and flinty gravel. Sub-soil: flinty gravel. Prevailing rocks, (Nos. 102, 80, and 98.) On the northwest of 15, northwest of 5, and southwest of 27, fragments of lead ore were discovered on the surface. The diggings in this township which have been most productive are on 28 and 21. On the northwest of 33 are "Renshaw's diggings," where about 30,000 lbs. of lead ore have been raised. On the northeast of 31, carbonate of zinc (No. 123) occurs; and on the southeast of 31, copper ore (No. 110) has been discovered.

Township 7.—No prairie, except a very small strip on *Helena* creek, and on the creek in the northwest corner of the township; chiefly oak openings; on the heads of the streams a few pine knobs. Well watered by streams and springs. Soil: very shallow, sandy, with fragments of flint. Sub-soil: sandy, with flinty gravel. Prevailing rocks, (Nos. 98, or 118, and 3' imbedding No. 116.) There have been no discoveries of lead ore in this township. Large quantities of iron ore (No. 15) are strewed all over the surface. "Heacock's" mill, on northwest of 34.

Fractional township 8.—North of *Helena* creek, prairie, except a few trees on the river and creek; south of *Helena* creek, oak openings, with a few spots of prairie on 25, 31, and 36. Soil: light colored, poor, and sandy; on the knobs, fragments of flint. Prevailing rocks, (Nos. 98, and 3', or 113.) Numerous pieces of iron ore (No. 15) scattered over the township. No discoveries of lead ore. The site for the town of *Helena* has been selected at the "*Shot-tower*," instead of the bend of the river at 36, where it is marked on the surveyor's map.

IN RANGE FIVE EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—Twelve or fourteen sections of rolling prairie (good farming land) north of the *Peccatonnica* river, except in the northeast corner; on the west side of the township, except on 31 and 32, oak openings. Tolerably well watered by streams and springs. Soil: north of the *Peccatonnica* river, sandy; south of the *Peccatonnica* river, less sandy, but on the ridges are fragments of chert (No. 68) interspersed through it. Sub-soil: clay, with fragments of chert. Prevailing rocks, (Nos. 3, 80, 129, and 130.) There are no important diggings in this township, but "gravel mineral" was found on southwest of 8; and it is said that pieces have been found on several of the sections on the west side of the township. In the southwest of 1 is a very fine yellow sand.

Township 2.—About five or six sections of rolling prairie; oak timber interspersed with prairie; some good timber on the west side of township, especially on the southwest. Very well watered by streams and springs. Soil: a dark mould. Sub-soil: in some places, a ferruginous sand. A very fine farming land. Prevailing rocks, (Nos 3, 80, and 118.) There are very extensive diggings on 18 and 19, on reserved land, claimed by Hamilton and Baldwin. These are the only important diggings. 200 lbs. of copper ore have been raised on the northeast of 4.

Township 3.—About four or five sections of prairie; the rest a scattering growth of white oak timber. Tolerably well watered by streams and springs. Soil: rather sandy. Prevailing rocks, (Nos. 3, 80, and 129.) There are no important diggings in this township. Lead ore has been found on the northwest of 28; and there are some diggings on northeast of 4 and southeast of 30. The geological indications are favorable for the discovery of lead ore.

Township 4.—About six sections of prairie near the centre of the township, on the west side of the *Peccatonnica* river; there is very little good timber; the growth consists of groves of timber and bushes ten feet high. Tolerably well watered, some good springs. Soil: sandy, third rate. Subsoil: an ochrey sand. In the north part of the township, the upper sandstone (specimen No. 98) forms the base of the hills; as you descend the *Peccatonnica* river, it dips gradually deeper, and, after crossing the west fork of that river, in township 1, in this range, it is no longer visible above the streams. Specimens Nos. 3 and 80 form the upper part of the ridges. Lead ore has been discovered in this township; some at "Fretwell's diggings," on 28, and some other places; but there are no lodes extensively worked at present.

Township 5.—A few spots of prairie, and some strips along the stream; chiefly a thin and stunted growth of oak; some tolerably good groves of small oaks and American aspen in the east. Tolerably well watered by streams and springs, but water is generally scarce on the ridges. Soil: except on the ridges, sandy, third rate. Prevailing rocks: Nos. 3 and 102 above, and No. 98 below. No discoveries of lead ore have yet been made in this township, though the surface indications are not unpromising.

Township 6.—About one-third rolling prairie; two-thirds a thin growth of stunted oak. Tolerably well watered by streams and springs. Soil: in the prairie, sandy, second rate. Prevailing rocks, (Nos. 82, 102, and 98.) About 50,000 lbs. of lead ore have been raised from a lode on southeast of 19; 10,000 lbs. on the south of 17. Near the centre of 14 are "Brigham's diggings," where a good deal of lead ore was raised. On 7, 8, and 18, are some less important diggings.

Township 7.—No open prairie of any extent; some narrow strips of prairie along the streams; township covered chiefly with oak openings. Surface very broken and rocky. Well watered by small streams. Soil: sandy, with rock beneath; in the north, poor, third rate; in the south, rather better. Prevailing rocks, (Nos. 98, 3', and 108.) No discoveries nor indications of productive lodes of lead ore.

Fractional township 8.—On 7, 8, south of 9, 15, 16, 17, 18, 19, 20, 21, and northwest of 22, is a level sandy plain; south part of 1, 2, 3, 10, and 11, northwest of 12, and 14, low wet land; the rest oak openings; surface rocky. Tolerably well watered. Soil: sandy, third rate. Sub-soil: rocky. Prevailing rocks, (Nos. 98, 3', and 108.) No discoveries of lead ore. A little iron ore (No. 15) strewed on the surface.

IN RANGE SIX EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—No prairie of any extent; the whole township is heavily timbered with white, Spanish, and black oak, and other varieties of timber, with a thick brushy growth of prickly ash running diagonally through the township, from southeast to northwest. Well watered in the west by

streams and springs. Soil: upland, first rate loam. Sub-soil: (where it was visible,) clay. The only ledges of rock visible, are on Skinner's branch; south of this branch, no rocks are visible, except a few small boulders. No diggings; no discoveries or indications on the surface of productive lodes of lead ore.

Township 2.—Rather more than one-fifth high rolling prairie, with thin oak openings; the rest oak openings, with some good groves of timber; the best timber is on the east side. Well watered by streams and springs. Soil: good second rate, sandy. Sub-soil: in some places a loam, in others a yellow sand. Prevailing rocks: Nos. 3 or 102 above; No. 98, of a yellow color, below. No discoveries of lead ore.

Township 3.—Nearly one-half broken prairie; the rest thin oak openings, and a few good groves of timber. Well watered by streams and springs. Soil: a good second rate mould. Prevailing rocks: Nos. 102, 129, and 130, above; No. 98 below. On the northeast of 8, are "Bigg's diggings," where 250,000 lbs. of lead ore have been raised. This is the only important discovery of lead ore in this township. In the east, loose masses of iron ore (No. 15) are of frequent occurrence.

Township 4.—About one-half high rolling prairie; one-fourth thin oak openings; and one-fourth good young timber. Very well watered by streams and springs. Soil: in the valleys, second rate; on the ridges, poor second rate and sandy; in the narrow bottoms, a sandy mould. A great quantity of chert is strewed over this township. Small pieces of iron ore (No. 15) are to be found on the surface. Prevailing rocks (Nos. 130 and 98.) No discoveries of lead ore have yet been made in this township.

Township 5.—One-third high, rolling prairie, and narrow strips of prairie on the streams; the rest of the township has a growth of oak openings, with occasionally a good grove of timber. Well watered by streams and springs. Soil: first-rate upland mould. Sub-soil: generally sandy. Prevailing rocks: Nos. 102, 103, and 80, above; and No. 98 below, rising about sixty or eighty feet above the bottoms. No important discoveries of lead ore have yet been made in this township. Small pieces of iron ore (No. 15) occur frequently, particularly on the east half of the township.

Township 6.—About one-half prairie, and one-half oak openings. No good timber in this township. Well watered by streams and springs. Soil: a good second-rate dark mould. On the ridges are loose masses of rocks, (Nos. 102 and 68;) low down, the sandstone (No. 98.) The diggings in this township are known by the name of the "Blue Mound diggings;" those owned by Brigham have been the most productive. From 300,000 lbs. to 400,000 lbs. of lead ore are raised at these diggings in a year; eight pits have yielded about 3,000,000 lbs. of lead ore. Where 15, 16, and 21 corner, large pieces of lead ore were discovered on the surface. It is highly probable that an important lode may be discovered here. A slightly curved line, running from this discovery northwest and southeast, would strike Brigham's and Shaw's diggings, (the most important lodes in the township.) One of Brigham's lodes is remarkable for its width, being thirty, and in some places fifty feet across, from wall to wall. This crevice has yielded fine specimens of carbonate as well as sulphuret of lead. The shafts are from forty feet to one hundred feet deep. Iron ore (No. 15) in detached masses was found in many places in this township.

Township 7.—No prairie; the timber is chiefly a tolerable good growth of Spanish and white oak. Very well watered by streams and springs. Soil:

generally very poor; some small valleys, but generally too wet and small for cultivation. Prevailing rock: a white sandstone, (No. 98,) with loose masses of specimen No. 102 occasionally above it. No diggings or discoveries of lead ore in the township. Some loose pieces of iron ore (No. 15) strewed on the surface.

Township 8.—On the main creek, a bottom of about one mile wide, of good rich land, without timber; also, in the northwest, strips of bottom between the numerous ridges; about one section of prairie bottom on 30 and 31; thin oak openings in the bottoms on the northwest and northeast; the south part, burr oak openings and numerous ridges. Well watered by streams and springs. Soil: in the bottoms, black, rich mould, first rate; on the ridges, poor and thin. Prevailing rocks (Nos. 98 and 3') imbedding masses of rock (Nos. 68 and 74.) Masses of very ferruginous sandstone (No. 118) frequently passing into iron ore (No. 15.)

Fractional township 9.—Mostly wet prairie; on 31, some oak openings; at the bottom of the bluffs in the east are some small patches of burr oak. Surface: on the east, very rocky and broken; between the bluffs some fine level strips of bottom land; swampy in the centre of the township, with some mounds connected by ridges. Soil: on the bluffs, nearly a pure sand, poor third rate; in the bottoms, first rate, dark and deep. Prevailing rocks (Nos. 98 and 118) with fragments of specimens Nos. 68 and 74. No discoveries of lead ore.

IN RANGE SEVEN EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—About one-third prairie; a strip running from northeast to southwest of fine rolling prairie, (excellent farming land:) two-thirds, a heavy growth of oak, walnut, hickory, and ash timber. Very well watered by streams and springs. Soil: a first rate, dark, rich mould. Sub-soil: clay. Prevailing rocks (Nos. 80, 129, 102, and 3.) Some boulders (No. 16.) There are some diggings in this township, but no important discoveries of lead ore have been made, although it is said that "gravel mineral" has been found. Though out of the range defined as mineral land, the rock in some places is of the same character as that which bears lead ore; so that it is possible that lodes of lead ore may hereafter be struck in this township.

Township 2.—Nearly half, fine rolling prairie; in the northwest, oak openings; in the southwest, good oak, walnut, and maple timber. Very well watered by streams and springs. Soil: in the prairie, a first rate, dark, upland mould. Sub-soil: generally clay. Prevailing rock (No. 80.) On 3, 10, and 11, are "Skinner's diggings," which have been worked for six or seven years, and it is supposed that 250,000 lbs. of lead ore have been raised. On the northwest of 10, a crevice was struck, and lead ore found; but, on account of some quarrel, the lode was not worked. On 28, and southwest of 35, some "gravel mineral" was discovered, and small pieces of "gravel mineral" are said to have been found occasionally as low down as *Buffalo Grove*. On the southwest of 13, some "float mineral" (loose masses of lead ore in clay or sand) have been found. No important discoveries of lead ore have been made in Wisconsin, farther southeast than this township.

Township 3.—Ten or eleven sections of rolling prairie; on *Sugar* creek a little marshy prairie; in the northeast and southwest, oak openings; in

the northwest, good oak timber. Very well watered by streams and springs. Soil: in the prairie and well-timbered land, second rate; in the oak openings, third rate, sandy. Prevailing rocks (Nos. 102, 130) on high ridges; in the base of the ridges, sandstone (No. 98.) In the southern part of the township this rock dips low; south of this, it is only seen in very low places. "Skinner's diggings" extend to the line between townships 2 and 3. No other important discoveries of lead ore have yet been made in this township. The ridge dividing the principal streams of this township is the commencement of the poor land extending towards the north.

Township 4.—One or two sections of rolling prairie; a small grove of good timber where 26, 27, 34, and 35, corner; the growth is ash, walnut, and oak; there are one or two other small groves of timber, of the same description; in all, not more than forty acres: the rest are oak openings. Very well watered by streams and springs. Soil: sandy, (but not as much so as farther north;) third rate. Sub-soil: sandy. On the ridges, the prevailing rocks are Nos. 130 and 102 above, and Nos. 98 and 3 below, imbedding No. 100. No discoveries of lead ore have yet been made in this township.

Township 5.—About three sections rolling prairie; the rest is a very stunted growth of oak: no good timber. Well watered in the north and south by streams and springs. Soil: third rate, sandy, and light colored. Sub-soil: sandy. Iron ore (No. 15,) scattered in loose detached masses on every section, and even quarter section, in the township. The prevailing rocks in the ridges are specimens Nos. 98 and 119. No diggings, and no discoveries of lead ore.

Township 6.—About three sections of rolling prairie; the rest, oak openings. Tolerably well watered; a few good springs. Soil: third rate, sandy. Sub-soil: sandy. Prevailing rocks: Nos. 102 above, and 98 below. No discoveries of lead ore. Some diggings for lead ore have been attempted in this township, but nothing was raised but sand. On 7, 8, 9, 16, and 17, large quantities of loose masses of iron ore (No. 15) were discovered, and the same ore occurs occasionally all over the township.

Township 7.—About three sections of bottom prairie in the north, and about six sections rolling prairie in the south; the rest a thin and stunted growth of burr oak. Tolerably well watered in the north by *Black Earth* creek, and in the south by *Sugar* creek. Soil: a second rate sandy mould in the prairie; in the south, on the ridges, poor and sandy. On southeast of 11, rocks No. 26′ above, and No. 98′ beneath. Ground frequently covered with loose pieces of crystallized brown oxide of iron, (No. 15;) there is hardly a section but is covered with it. Veins of iron ore, three or four feet wide, were discovered in the sandstone. Unfortunately, much of it in these situations is contaminated with sand. Large quantities of the pure crystallized variety could, however, be collected in the township: and there is every probability that many veins of good ore can also be found disseminated in the rock. In the township north of this, the upper sandstone (No 98) runs out, and the inferior strata (Nos. 3 and 98′) occupy even the high ridges.

Township 8.—Some small strips of wet prairie; the greatest part of the township has a growth of burr oak openings; surface of land very broken. The south part and west half tolerably well watered by streams and springs; the rest of the township is almost destitute of water. Soil: poor, sandy, third rate. Sub-soil: sand, gravel, and rocks. Prevailing rocks, (Nos. 109

or 3', 98', and 26';) no fossils. Small pieces of iron ore (No. 15) very frequent. No discoveries of lead ore.

Township 9.—No prairie; the whole township has a very thin and stunted growth of burr oak; surface very broken; not well watered. Soil: poor, third rate, sandy; where the surface is level, the ground is wet. Prevailing rocks, Nos. 109 or 3', and 112, above, and No. 98' below. Considerable masses of iron ore (No. 15) all over the township. No appearances or discoveries of lead ore.

Fractional township 10.—About five sections of rolling prairie; the rest burr and white oak openings, with the exception of three-fourths of a section on the west half of 34, east half of 33, and all of fractional section 1, where there is some tolerably good timber. Not well watered; no water but some ponds and part of a lake on 1 and 2. Soil: generally poor, sandy, third rate; on the sides of the ridges gravelly. Sub-soil: sand and rock. The surface is studded with small knobs. Prevailing rocks; lower sandstone, (No. 98';)) on the tops of the ridges, in places, (Nos. 3' or 109.) Iron ore, (No. 15,) in small pieces, strewed over the surface; in some places the ground is covered. No appearance of lead ore.

IN RANGE EIGHT EAST OF THE FOURTH PRINCIPAL MERIDIAN.

Township 1.—Chiefly high, rolling prairie; the west tier of sections have a growth of good timber; in the northeast there are about two sections of timbered land; well watered by streams and springs. Soil: a dark, second rate, and rather sandy mould. Sub-soil: rather sandy. Prevailing rock (No. 130.) In travelling north, (rising for the first time to the surface,) the upper sandstone (No. 98) is to be seen in the lower part of the ridges, on a branch of *Sugar* creek, on the northeast of 10. A few boulders to be seen now and then. On the northeast of 17, lead ore has been found in small quantities. On the northeast of 21, "gravel mineral" was discovered, but no important lodes of ore have been struck.

Township 2.—About one-third rolling prairie in the south and north; a strip of good young black, white, and burr oak timber, through 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 25, and 26, and part of 28, 29, and 30; the rest is oak openings. Well watered by streams and springs. Soil: second rate, sandy. Sub-soil: sandy. Prevailing rocks (Nos. 102 and 98.) No discoveries of lead ore, but in a few places there are some indications of mineral.

Township 3.—About one-half high rolling prairie; the north half chiefly good, tall, black and white oak timber; on 6, 7, and part of 18, are oak openings. Very well watered by streams and springs. Soil: very sandy. Prevailing rocks: Nos. 130 and 3 above, and No. 98 below. No discoveries of lead ore have yet been made in this township.

Township 4.—On 26, 27, 28, 33, 34, 35, and part of 5, 7, and 8, high, rolling prairie; a strip of low marshy prairie in the east; tolerably good timber in the west; the rest oak openings. Well watered by streams and springs. Soil: third-rate; sandy, with flinty fragments disseminated in it; in places the ground is almost covered with pieces of chert, (No. 68.) Prevailing rocks: Nos. 130 and 80 above, and No. 98 below. There are several important diggings in this township, called the "Sugar Creek diggings." On the southwest of 26 are "Kelly's diggings," where about 8,000 pounds of lead ore are raised in three weeks. On the north of 34, are "Slater's diggings," where 15,000 pounds of lead ore are raised in a month. On the southwest of 27 are valuable diggings, owned by "Inman & Breese." No

lodes of lead ore in Wisconsin, east of *Sugar* creek. Some loose pieces of iron ore (No. 15) on the surface.

Township 5.—About one section of high prairie, and a strip of wet prairie, on 4, 9, and 10. On 26 and 35 is good oak timber; the rest is a thin and stunted growth of oak. Well watered both by streams and springs. On Sugar creek and its branches, are some good mill seats. Soil: poor, sandy, third rate. Sub-soil: sand. Prevailing rocks (Nos. 118 and 98) high up on the bluffs. No discoveries of lead ore. A great many pieces of iron ore (No. 15) on the surface.

Township 6.—About ten or eleven sections of rolling prairie; the southern sections good burr oak timber; the rest a stunted growth of oak openings. Tolerably well watered by streams and springs in the west and south. Soil: poor, third rate, sandy. Sub-soil: sandy; poor farming land. Prevailing rocks (Nos. 3′ and 98′.) No discoveries of lead ore; small pieces of iron ore (No. 15) found on the surface.

Township 7.—About five sections of fine rolling prairie; the rest is principally burr oak openings. In the north are numerous ponds; the middle and south not well watered. Soil: in the prairie, a first-rate upland mould, but rather too sandy; in the south, second rate; in the north, third rate. Sub-soil: sandy. Prevailing rocks (Nos. 109, 26′, 112, and 111.) Iron ore (No. 15) in loose masses on the surface. A small piece of lead ore was found on the surface in the northwest of 7, with crystallized carbonate of lime, (No. 31;) but no important discoveries of lead ore have been made in the township.

Township 8.—About two-thirds rolling prairie; about five sections of good timber on 4, 5, 6, 7, and 18; on 1, 2, and 3, are oak openings; on 28, 29, 30, 31, 32, 33, 34, 35, and 36, burr, black, and white oak timber. Not well watered. Soil: in the prairie, a first-rate sandy mould. Sub-soil: sandy. Prevailing rocks, (Nos. 109, 3′, 26′, and 112.) In the south are numerous boulders of hornblende rock, some of them very large, (say ten or twelve feet high.) Iron ore (No. 15) very abundant in small detached masses all over the township. No discoveries of lead ore. North of the *lakes* are some *Indian* diggings and *Indian* furnaces.

Township 9.—About one-half rolling prairie; the other half oak openings. Along the western margin there is some tolerably good timber. Very poorly watered—one small stream on 4, 5, and 8. Soil: poor third rate. Prevailing rocks (Nos. 3′, 26′, 109, and 98′.) Loose masses of iron ore in many places over the township; and some thin veins of iron ore (No. 15) discovered in chert (No. 68.) Some boulders. No discoveries of lead ore.

Fractional township 10.—About six sections of low rolling prairie in the south. On 19, 20, 21, 7, 8, 9, 16, and 17, are about four sections of low prairie; about six sections of high prairie in the east; and on 3, 4, and 5, about two sections of tamarack swamp; the rest is oak openings. Surface of land broken. Well watered both by streams and springs. Soil: poor and sandy. Sub-soil: a brown sand. Prevailing rocks (Nos. 3′, 111, and 98.) No discoveries or appearances of lead ore.

Fractional township 11.—In the southeast, about half a section of prairie; high bluffs, with a few pine and oak trees along the *Wisconsin* river. A tamarack swamp runs through the centre of the township, parallel with Wisconsin river. South of this is a growth of stunted oak timber, occupying about three sections. No springs. Soil: almost a pure sand. Prevailing rocks (Nos. 3′ and 98′.) On the northwest of 36 are some detached pieces of iron ore, (No. 15.)

Table showing the proportion (in decimals) of prairie and timber in each township in the Dubuque district.

No. of towns.	Range 1 W. of 5th mer.		R. 2 W. of 5th m.		R. 3 W. of 5th m.		R. 4 W. of 5th m.		R. 5 W. of 5th m.		R. 6 W. of 5th m.		R. 7 W. of 5th m.		R. 8 W. of 5th m.		R. 1 E. of 5th m.		R. 2 E. of 5th m.		R. 3 E. of 5th m.		R. 4 E. of 5th m.		R. 5 E. of 5th m.		R. 6 E. of 5th m.		R. 7 E. of 5th m.	
	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.
78	.90	.10	.63	.37	.97	.03	.67	.33	.97	.03	–	–	–	–	–	–	.92	.08	.76	.24	.70	.30	.67	.33	–	1.00				
79	1.00	–	.70	.30	.80	.20	.97	.03	.65	.35	.75	.25	–	–	–	–	1.00	–	.94	.06	1.00	–	1.00	–	.67	.33				
80	.80	.20	.80	.20	–	1.00	.80	.20	–	–	–	–	–	–	–	–	.94	.06	.86	.14	.90	.10	.90	.10	.90	.10	.67	.33		
81	.90	.10	1.00	–	.90	.10	.75	.25	–	–	–	–	–	–	–	–	.90	.10	1.00	–	.85	.15	.85	.15	.99	.01	.88	.12	–	1.00
82	.97	.03	1.00	–	.99	.01	.52	.48	–	–	–	–	–	–	–	–	.90	.10	1.00	–	.97	.03	.76	.24	.50	.50	–	1.00	.50	.50
83	.90	.10	.75	.25	.66	.34	.90	.10	–	–	–	–	–	–	–	–	.98	.02	1.00	–	.96	.04	.92	.08	.91	.09	.98	.02	.88	.12
84	.90	.10	.98	.02	.85	.15	.33	.67	.80	.20	–	–	–	–	–	–	.67	.33	.33	.67	.33	.67	.75	.25	.65	.35	.65	.35	.50	.50
85	.50	.50	.50	.50	.92	.08	.75	.25	.80	.20	–	–	–	–	–	–	.20	.80	.50	.50	.06	.94	.75	.25	.15	.85	.50	.50		
86	.60	.40	.35	.65	.50	.50	.88	.12	.80	.20	.75	.25	–	–	–	–	.01	.99	.36	.64	.98	.02	.75	.25	.33	.67				
87	.75	.25	.50	.50	.80	.20	.33	.67	.98	.02	.99	.01	–	–	–	–	.87	.13	.66	.34	.33	.67	.90	.10						
88	.90	.10	.87	.13	.85	.15	.25	.75	.55	.45	.99	.01	.99	.01	–	–	.67	.33	.45	.55	.40	.60	.20	.80						
89	.20	.80	.70	.30	1.00	–	.94	.06	.70	.30	.90	.10	1.00	–	–	–	.02	.98	1.00	–	.50	.50								
90	.30	.70	.50	.50	.75	.25	.50	.50	.87	.13	.50	.50	.94	.06	.99	.01	.12	.88	.90	.10										
91	–	1.00	–	1.00	–	1.00	–	1.00	.22	.78	.35	.65	.97	03	1.00	–	–	1.00												
92	–	–	–	1.00	.06	.94	.10	.90	.50	.50	.70	.30	.50	.50																
93	–	–	–	1.00	.11	.89	.50	.50	.88	.12																				
94	–	–	–	–	.09	.91	.85	.15	.94	.06																				
95	–	–	–	–	–	1.00	.35	.65																						
	9.62	4.38	9.28	6.72	10.25	7.75	10.39	7.61	9.66	3.34	5.93	2.07	4.40	.60	1.99	.01	8.20	5.80	9.76	3.24	7.98	4.02	8.45	2.55	5.10	3.90	3.68	2.32	1.88	2.12

Total, 106.57 prairie, 56.43 timber; equal to two-thirds prairie and one-third timber.

NOTE.—All tracts of land covered with a small growth of oak, standing from ten to twenty feet apart, (called in the West "oak openings,") have been set down in the foregoing table as timber; and at least two-thirds of all the timbered country is of this description.

Table showing the proportion (in decimals) of prairie and timber in each township in the Mineral Point land district.

Range 1, west of 4th meridian.			Range 2, west of 4th meridian.			Range 3, west of 4th meridian.			Range 4, west of 4th meridian.			Range 5, west of 4th meridian.			Ranges 6 and 7, west of 4th meridian.		
Township.	Prairie.	Timber.	Township.	Prairie.	Timber.	Township.	Prairie.	Timber.	Township.	Prairie.	Timber.	Township.	Prairie.	Timber.	Township.	Prairie.	Timber.
1	.99	.01	Frac. 1	.34	.66	Fr. 1 & 2	–	1.00	Fr. 2 & 3	.34	.66	Frac. 3	.95	.05	Frac. 3	.50	.50
2	.50	.50	2	.06	.94	3	.09	.91	4	.18	.82	4	.99	.01	Frac. 4	.98	.02
3	.37	.63	3	–	1.00	4	.20	.80	5	.99	.01	5	.98	.02	Frac. 5	–	1.00
4	.10	.90	4	–	1.00	5	.50	.50	6	.50	.50	Frac. 6	.50	.50	Frac. 6	–	1.00
5	.50	.50	5	.34	.66	6	.50	.50	Frac. 7	–	1.00	Frac. 7	–	1.00			
6	.17	.83	6	.34	.66	7	–	1.00									
7	–	1.00	7	–	1.00	Frac. 8	.60	.40									
8 and 9	.34	.66	Fr. 8 & 9	.10	.90												
	2.97	5.03		1.18	6.82		1.89	5.11		2.01	2.99		3.42	1.58		1.48	2.52

TABLE—Continued.

Range 1, east of 4th meridian.			Range 2, east of 4th meridian.		Range 3, east of 4th meridian.		Range 4, east of 4th meridian.		Range 5, east of 4th meridian.		Range 6, east of 4th meridian.		Range 7, east of 4th meridian.		Range 8, east of 4th meridian.	
T'nship.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timber.	Prairie.	Timb'r.	Prairie.	Tim'r.	Prairie.	Timb'r.
1	.99	.01	.75	.25	.98	.02	.50	.50	.34	.66	–	1.00	.34	.66	.80	.20
2	.66	.34	.99	.01	.51	.49	.12	.88	.18	.82	.25	.75	.50	.50	.34	.66
3	.91	.09	.34	.66	.03	.97	.15	.85	.15	.85	.50	.50	.34	.66	.50	.50
4	.34	.66	.12	.88	.98	.02	.34	.66	.18	.82	.50	.50	.03	.97	.30	.70
5	.95	.05	.50	.50	.33	.67	.20	.80	.10	.90	.36	.64	.01	.99	.04	.96
6	.50	.50	.35	.65	.66	.34	.50	.50	.66	.34	.50	.50	.01	.99	.33	.67
7	.14	.86	–	1.00	.06	.94	.01	.99	.99	.01	–	1.00	.30	.70	.16	.84
8	.08	.92	–	1.00	–	1.00	.52	.48	.50	.50	.36	.64	.01	.99	.66	.34
9	–	–	–	–	–	–	–	–	–	–	.98	.02	–	1.00	.50	.50
10	–	–	–	–	–	–	–	–	–	–	–	–	.20	.80	.60	.40
11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.50	.50
	4.57	3.43	3.05	4.95	3.55	4.45	2.34	5.66	3.10	4.90	3.45	5.55	1.74	8.26	4.73	6.27

Total, 39.48 prairie, and 67.52 timber; equal to about three-eighths prairie and five-eighths timber.

Note.—All tracts of land covered with a small growth of oak, standing from ten to twenty feet apart, (called in the West "oak openings,") have been set down in the foregoing table as timber; and at least three-fourths, if not four-fifths, of all the timbered country is of this description.

No. V.

REPORT OF JOHN LOCKE, M. D.

To David Dale Owen, M. D., principal agent to explore the mineral lands of the United States:

Sir: Having, at your complimentary solicitation, been appointed your assistant in the late survey of the mineral lands of the United States, and having been charged by you with those duties most agreeable to my former pursuits, (viz: the *physical department*,) including, especially, the barometrical observations, the measured altitudes, and the geological sections, it is with peculiar pleasure that I submit to you the following

REPORT:

The subjects to which my attention was chiefly directed, and which will mark the heads or divisions of this report, are as follows:

1. A comparison between the rocks of the lead or mineral region, and those of Ohio, Indiana, and Kentucky, called the "cliff limestone," showing their probable identity.
2. Several sections of strata (the height and thickness being determined by the barometer) with drawings.
3. The altitudes of table lands, hills, mounds, and mountains, determined by barometrical observations, with a chart.
4. The result of numerous observations and calculations on the elements of terrestrial magnetism, including the dip, declination, and force or intensity, of the magnetic needle at several places between Cincinnati and the region surveyed, and in that region itself, accompanied by two charts; together with some remarks on the practical uses of these elements of magnetism.
5. Surveys of a few of the earthwork antiquities of Wisconsin, with drawings.
6. Some observations on the climate and meteorology of the upper Mississippi.
7. Acknowledgments and concluding remarks.

I.—THE LIMESTONE CONTAINING THE LEAD ORE OF THE UPPER MISSISSIPPI, COMPARED WITH OTHER ROCKS, AND ESPECIALLY WITH THE "CLIFF LIMESTONE" OF OHIO.

From the examinations which we have lately made, I am of opinion that the limestone containing the chief deposites of the lead in Iowa, Wisconsin, and Illinois, is a part of a stratum of great extent in our own country, and possibly is geologically identical with rocks found in other continents.

The following appear to me to be some of the synonymes by which our own geological writers have intended to designate this stratum:

"Galeniferous limestone," Featherstonhaugh.
"Corntiferous limestone," Eaton.
"Magnesian limestone," Keating and Shepherd.
"Metalliferous limestone."
"Cliff limestone."

This last name I intended, in my report on the geology of Ohio, to be merely a provisional one, like the numerical distinctions used by Professor Rogers; it was adopted from the inhabitants on the Miami, above Dayton, in Ohio.

In Major Long's "Expedition to the Source of the St. Peter's," in 1823, there is a very interesting article on this rock, by Mr. Keating. These observations were descriptive of the geological formation on the "Wassamon," ten or twelve miles northeast of the present town of Galena. The external characters there sketched by him apply very generally to this formation; they are, in substance, briefly as follows:

Horizontally stratified structure, crystalline, sandy, or gravelly; cellular, cells sometimes filled with crystallized carbonate of lime, contains much white hornstone, (flint or chert,) often in flattened nodules, lying in horizontal strata; organic remains rather uncommon, consisting of terebratulites, encrinites, and madriporites, (*Linn.*)

These characters, it is remarked by Mr. Keating, are similar to those of the carboniferous or mountain limestone of Messrs. Conybeare and Phillips, or the metalliferous limestone of other geologists; similar, also, to zechstein and rauchwacke of Thuringen, described by Mr. Friesleben. But Mr. Keating is not of opinion that the limestone of the "Wassamon" is identical with those foreign rocks, for he believes it to be "of a much later formation," and "to be connected with an oölite observed between Prairie du Chien and St. Anthony."

The *oölitic* limestone, at and above Prairie du Chien, is not a real oölite; and we found it to be older than, and below, the cliff stone of the "Wassamon." Mr. Keating seems to have taken the impression that the rocks of Wisconsin are above the coal formation, and reasons accordingly. He observes, (page 197:) "It is probably connected, as we have already intimated, with the limestone situated *above* the coal fields of Wheeling and Zanesville; it extends over those parts of Ohio and Indiana where salt has been found." Our investigations, you know, have led us to an opposite conclusion, viz: that the rocks of the lead region are *below* the coal. Mr. Keating seems to have been aware that his conclusions, drawn from so rapid and so slight an examination, might not be correct, as appears by the following remark: "Let it be remembered that we only offer this as a suggestion to the future investigator of our Western limestone, in order that he may turn his attention to the subject with more favorable opportunities for observation than those afforded us by a transient visit through the country." The following conclusion of Mr. Keating does credit to the science of geology in general, and to the author in particular: "If, as Mr. Friesleben has described it, the zechstein presents specks of galena or sulphuret of lead; if, as Mr. Conybeare states, the galena is seen occurring in strings in the magnesian limestone of Nottingham and Durham; if it has occasionally been found in the conglomerate beds associated with this formation, especially near Mendip hills, in England; if it contains veins of sulphate of barytes at the Huddlestone quarry, near Sherburne, between

Ferrybridge and York; if it is traversed by veins of sulphate of barytes, near Nottingham and Bramham moor, &c.—may it not then be asked, whether these considerations do not render it probable that the great lead deposite in the West is in this limestone? And is it not likely that all that has been worked in an alluvion has been detached from this formation? These are questions upon which, in the present state of our acquaintance with the Western limestone, we must profess ouselves unable to give any decided opinion; but, from various circumstances which we need not dwell upon, we should incline to consider the lead ore as probably existing in an older limestone, beneath the coal formation."

Situated as was Mr. Keating at the moment of making these observations, in the centre of one of the most productive lead regions in the world, with veins of lead ore probably beneath his feet, it will be thought surprising, by those not acquainted with geology, that he did not make the discovery. His failing to do so is attributable, not to a want of skill or industry on his part, but to the want of time and opportunity to make the necessary examinations.

Since the time in which Mr. Keating wrote this article, geologists have become less confident in geological identities and correspondences in countries remote than they were at a previous period; and the principles laid down by Professor Phillips, in a late publication, will, I presume, meet with general concurrence. After giving a table of the order and superposition of "the British stratified rocks," he proceeds to observe "that the series of strata classed in the preceding table is always recognisable, wholly or partially, in every part of the British islands; that is to say, the stratified rocks, occurring in any situation, can be referred to their respective types in the general table. But the local variations are considerable; several of the stratified rocks are only of limited extent; even whole formations, as the oölitic formation, change their characters, or, as the millstone grit, are entirely extinct in particular regions, where the groups above and below them are complete. This being the case, it is evident that such subdivisions are too minute and variable to be employed between British and foreign series of strata; we must be satisfied with comparing formations, and, in some cases, omit even these, and look only to the succession of *primary, secondary, and tertiary classes of rocks.*"

This examination has been made in almost all parts of the world; no where, indeed, except in Europe, and certain portions of the other continents, completely, yet every where sufficiently to establish the truth of the following propositions:

"1st. The series of British strata represents very well the succession of stratified rocks in Europe, parts of Africa, Asia, and North America; *this agreement is most strict in those parts which are nearest to the British islands, and becomes more vague and indefinite as the distance increases,*" &c.

"2d. In all parts of the globe, where a considerable extent of country has been examined, stratified rocks have been found," &c.

It seems to follow, from the first of these propositions, that, instead of jumping at once from the examinations of a rock in one locality, to the correspondence with a rock or formation in a very remote country, we ought first to trace, as far as possible, the continuity, correspondence, order, and superposition, of the rocks in our own, or any other country examined.

If, as many have supposed, the lead-bearing limestone of the Mississippi

is identical with the magnesian limestone of Great Britain, it ought to occupy a place above the coal. That it is super-carboniferous, we have no evidence whatever in the Territories. On the contrary, though the strata emerge in succession from beneath this formation, and present themselves to the eye of the geologist to the depth of from six hundred to one thousand feet as he ascends the river, still not a vestige of coal appears associated with these inferior beds.

From a careful personal examination of the rocks at numerous localities of both regions, viz: in Ohio, Indiana, and Kentucky, on the one part, and in Iowa, Wisconsin, and Illinois, on the other, I am satisfied of the following agreement or correspondences:

1. The rocks, both in Ohio and in the lead region of the upper Mississippi, are horizontally stratified in distinct layers, separated generally by simple joints—the layers being of various thicknesses, from a few inches to eighty or one hundred feet; they are traversed vertically by fissures which are often several feet wide, and filled with red clay* or lead—with red clay in Ohio, but with red clay and lead in Iowa and Wisconsin.

2. In consequence of being thus fissured, the rocks in both localities, when partially removed, by streams or otherwise, form mural or overhanging cliffs; hence it has been denominated the "cliff limestone."

3. They agree in external characters; being, for the most part, a tolerably pure magnesian limestone, which effervesces but imperfectly with acids, until reduced to powder.

The above requires many qualifications, as the characters are much varied in different localities; but even in these qualifications there is an agreement in the rocks of the two regions. The texture is more or less crystalline; often compact and firm, so as to form a good building stone, or even to receive a polish as a marble—as at Eaton, Dayton, and Columbus, in Ohio, and at Sinsinewa Mound, in Wisconsin. In some places it is so tender and friable, that it can be broken down by the fingers—as at the north line of Butler county, in Ohio, and at the Natural-rock wells on the *Wapsipinecon* river, in Iowa. It is sometimes disintegrated to the consistence of sand or gravel, as at Locust Grove, in Adams county, Ohio, and at numerous localities in the lead region. It is often cellular, like the internal spongy structure of large bones; a character which has given to it in the vicinity of Columbus, Ohio, the popular name of horsebone limestone. The prevailing color is a light drab, or yellowish white; but it is often of a reddish or ferruginous brown: this last color prevails on the Miami, eight or ten miles above Dayton, in Ohio, and is common in the neighborhood of Dubuque, in Iowa. At the *Menomonie* river, a small stream between Dubuque and Sinsinewa Mound, a thick compact stratum, suitable for building, presents itself in a perpendicular cliff, which is of a chocolate brown. I believe the same layer extends to Dubuque, retaining there the same color. In a few situations, the yellowish and red tinge is wanting, and the color becomes an ash gray, or a simple mixture of black and white.

4. The rock abounds in both localities with chert, (flinty nodules,) which lie horizontally flattened and semistratified, presenting lines or ranges in the vertical cliffs; these flinty nodules are fractured into angular fragments as they lie in their place, and similar fragments are also often found abund-

* Red clay fills the fissures of the cliff limestone at Columbus, and at numerous localities in Adams county, Ohio.

antly in the beds of streams; they are of various colors—transparent, opaque, white, reddish and carnelian-like, yellowish, and sometimes banded like agate; the chert is more abundant in the lead region than in Ohio.

5. The rocks agree in their modes of weathering, by which they often acquire an indescribably rugged and fantastic outline; being not only formed into points, angles, and cavities, but often perforated and riddled by vermicular holes of various sizes.

6. In many places, the stone seems to consist of two kinds of matter, differing in color, hardness, and durability, and imperfectly mixed and blended together, as if one had been formed into a spongy or scorious mass, and the other cast into it to make it solid; when sufficiently compact for polishing, this kind of the rock forms an agreeable mottled marble, as at Columbus, in Ohio. Perhaps this structure gives rise to the peculiar mode of weathering above described.

7. The rock in both regions is metalliferous, containing lead, iron, zinc, and manganese; lead is rare in Ohio, but the other metals are not uncommon. The Brush creek iron ore, in Adams county, Ohio, is in this rock.

8. The rock contains considerable quantities of calcareous spar, or crystallized carbonate of lime, disseminated in masses of several inches, or even feet. The spar is abundant in Adams county, Ohio; where it is often rendered opaque by a black substance pervading it, when it assumes the appearance of "galena;" the same blackened spar occurs in the mines of Dubuque. Sulphate of barytes (heavy spar) is found, rather locally, however, in both localities; and sometimes small quantities of sulphate of lime, probably formed by the decomposition of nodules of iron pyrites.

9. The cliffs in Ohio, and those in Iowa, seem to produce by disintegration similar soil and the same vegetation; they are both surmounted by cedars; they occasionally bear the hemlock, (pinus canadensis;) and the ground hemlock, (taxus canadensis;) in the precipitous ravines, they have tufts of the same purple-stemmed fern, (pteris atropurpurea,) growing from the crevices of the perpendicular rocks, and have the overlying table lands covered with forests of oaks, or with the grass of the open prairie.

10. The superposition, both in Ohio and Iowa, seems to be the same; the cliff rock in both having the blue fossilliferous limestone immediately beneath it. The cliff rock in Iowa, Wisconsin, and Illinois, so far as it came under my observation, occupies the surface, and it was therefore not apparent what belongs properly above it. In Ohio, the cliff is succeeded above by the black bituminous slate or shale.

11. It is often bituminous; apparently more so in Ohio than on the Mississippi.

12. The fossil remains found in the lead region agree with those found in Ohio. Some of them are as follows:

I. *Multilocular shells.*—Orthoceratites.

II. *Crustaceans.*—Several species of calymene, asaphus, and isotelus, more abundant, it appears to me, in Ohio, than on the Mississippi.

III. *Crinoideans.*—In many localities the button-like joints of the stems of various species of stone lilies are abundant. The column imbedded in limestone has often decayed, and left a mould or cavity, in which the slender axis is still entire, like a slender wire along the axis of a cylindrical cavity. I have seen this at West Union, in Ohio, and in the huge masses of chert of the Blue Mounds.

IV. *Molusca.*—Spirifers, terebratulæ, and delthyris. A cast of several

species of a bivalve occurs, singularly alike, at Eaton and Springfield, in Ohio, and on the banks of the *Makoqueta* river, in Iowa—the pentamorus. The cast of the interior presents a thick oval figure, with four beaks; two of which are longer, and separated by a deep fissure, into which enters a sharp septum. This fissure between the longer beaks gives a distant resemblance to a cloven hoof; hence the common name of "petrified pigs' feet." They are often so abundant, that they lie in actual contact. The substance of the shell itself appears to be entirely wanting; and we find only the cast or mould, both of the exterior and interior; the shape of the shell being a cavity. No fossil appears to be more characteristic of this formation than these casts, perhaps rather from their peculiar condition than from the specific character of the fossil itself.

V. *Zoophytes.*—Corallines are abundant in both regions; of cyathophylla, several species; of calamopora, (Goldfuss,) several species; of catenipora, at least three species are nearly equally abundant. The eschara, (of Goldfuss,) which is abundant on the Miami in Ohio, and which I once thought characteristic of this stratum, seems to be limited to particular localities. I did not see it in the lead region.

II.—GEOLOGICAL SECTIONS.

These were measured, barometrically, in the same manner as were the heights, as described in the succeeding article. I proceed to make a few remarks upon each, separately:

Section No. 1—through Dubuque.

[See plate No. 19, figure No. 1.]

This section commences about the centre of township eighty-nine north, range one east of the fifth principal meridian, at the point where the banks of Little Makoqueta river first attain their chief elevation; and is extended through Dubuque to Sinsinewa Mound, about fifteen miles. The heights along the top of this section are marked at the points where they were taken. It appears that Sinsinewa Mound is scarcely higher than the general table on the upper branches of Little Makoqueta; its apparent elevation is caused by a "degradation" of the region immediately surrounding it.

The limestone at the top of Sinsinewa Mound is in large, well-defined strata, of a light color, uniform texture, harder than the cliff stone is usually found, and in every respect suitable for a building stone. The same seems to be true, at the same elevation, at the opposite end of the section. I have represented this limestone by a different character; but the line of demarcation is not very definite. The lower portion, three hundred feet, apparently filled with veins of lead ore, is the most interesting development of the cliff rock which I have seen. I have sketched in some vertical veins to represent, *in general*, the lead ore. I hope no one will imagine that I found veins exactly where these are sketched. Our rapid journey through the region explored did not permit us to dig and blast the rocks to uncover veins of galena. This is a special and peculiar business, and gives origin to a special and peculiar title—that of "prospecter."

This section shows the heights of several points, the general position of the strata, and especially the situation of the blue fossilliferous limestone, which, you inform me, probably limits the *thick* veins of lead ore. I did not find the blue limestone directly in the range of this section; but, from

its situation above low water at Eagle point, and at the lower mills on Little Makoqueta, only about two miles distant, and the strata nearly horizontal, it must occupy very nearly the place which I have assigned in the section. A geologist residing for months, or perhaps years, at Dubuque, might subdivide this section—trace out the "cap-rock," the thin layers of shale—give specimen sections, ground plans, &c., of individual veins, and a variety of matters relating to such a locality, which would be interesting and useful. But the period of a few days, and that crowded with a variety of duties, did not permit the accomplishment of more than was done. I have purposely avoided any thing particular on the *lead veins*, as I knew that you had much better opportunities for getting information on that subject than it was possible for me to have enjoyed.

A geological speculation.—In viewing this section, it appears evident that the south fork of the Little Makoqueta (a stream barely large enough to turn a mill) has, by abrading its channel for countless ages, worn its bed to the depth of four hundred feet in solid limestone. Is it not probable, then, that the rocks once extended nearly in an uninterrupted level from the heights of Little Makoqueta to the top of Sinsinewa Mound, and that the mighty Mississippi has rolled its tide long enough to have worn the chasm, the centre of which it is shown to occupy in the section? Is it not probable that the whole surface of the country in that region is now many feet, many hundred feet, indeed, lower than when it first became dry land? Rocks have turned to dust, and the dust been washed away; stones have dissolved, and the solutions have been poured into the sea. The springs of Iowa show that they have levied tribute from the solid rock, and the waters of the Mississippi tell that they are transporting it to ocean depths. The lead ore piled loosely on the top of corroded limestone shows that the matrix of its vein, into which it was originally cast, has abandoned it to fall down like a ruined wall; a few points, covered by harder materials, remained; gathered the sloping tablets of strata about their shoulders; reared their heads in defiance to a million of storms; and now, in form of conic mountains, point out a few landmarks of earth's olden boundary.

Section No. 2—at Prairie du Chien.

[See plate No. 19, figure No. 2.]

Here, compared with Dubuque, we find almost an entire change of rocks. Lower strata have been gradually rising, until those which at Dubuque were at the water's edge are nearly at the hill tops; and the cliff limestone, which at Sherald's Mound is six hundred feet thick, is here a mere outlier, either entirely wanting, or just capping the hills; while layers of new species of rock, previously unseen, are raising themselves to light, and form the base and main mass of the hills.

The following is a table of the strata, beginning at the top:

	Feet.
I. Soil and cliff limestone - - - - -	60

I found but one specimen evidently *in situ*, and containing a fossil rather abundant at Dubuque—a species of coralline resembling the disk of a sunflower.

II. Blue fossilliferous limestone (abounding with its characteristic fossils, and having its usual external characters) alternating with blue clay marl, the layers of stone very thin, and apparently corroded. I believe it to be identical with that at Cincinnati. I

found it in a chasm not filled by other rocks, one hundred and fifteen feet thick; but the stone was no where seen to fill that space, or to be more than thirty feet thick - - - - - - 115

III. Buff-colored limestone in distinct well-formed layers, including many portions or masses of white calcareous spar, and imbedding few or no organic remains - - - - - - 20

IV. *Soft saccharoid sandstone*, consisting of sharp angular, transparent, minute fragments of quartz, scarcely cemented. It sometimes contains calcareous matter enough to effervesce freely with acids. It is often almost perfectly white, though sometimes colored reddish or brown by iron; when it is thus colored, it is often more strongly cemented. Its close resemblance to common moist unrefined sugar (especially the better or whiter kinds of sugar) does not fail to strike every person who examines it. Although the texture is so loose that a specimen can scarcely be broken off without falling to the state of incoherent sand, yet this rock crops out extensively, and seems to stand the weather as well as other strata which are substantial enough for building stones. I suppose, by its great porosity, it scarcely retains water enough to heave it by frost sufficiently to disintegrate it. I did not find precisely the lower termination of this rock, but, from having seen nearly forty feet of it exposed, I have ventured to give that thickness to it in the section - - - - - - - - 40

V. A portion not examined, probably similar to the lower magnesian limestone described next - - - - - - 40

VI. Lower magnesian limestone, resembling the cliff rock, but differing from it, however, in being almost destitute of organic remains. The lower beds of this stratum frequently afford a good building stone. This stratum exhibits, in some places, alternations of thin layers of sandstone, and some layers of limestone perfectly oölitic in structure. It includes many nodules of chert of a chalky whiteness: it contains, also, veins of so bright a green color as to excite the idea of copper ore, but yielding no evidence of that metal when examined by a proper test. At the point marked "stone quarry," this rock has been quarried for building in Prairie du Chien. It appears to dress very well, has an agreeable light-drab color, and shows every evidence of durability - - - - 190

It will be seen that the stone crops out beyond the soil at three different points upon the hill side, A, B, and C. These outcroppings are continuous, so as to form three continuous parallel lines for miles in length, and serve to divide the hill into zones, called "benches." When seen from the opposite side of the river, they appear exceedingly straight and well defined, and afford a singular feature in the picturesque landscape.

VII. There is, upon the side of the river opposite to Prairie du Chien, a stratum of sandstone thirty feet thick at the water's edge, identical in character with that three hundred feet higher - - 30

Total - - 495

PLATE Nº 20

FIG. Nº 1.

SECTION OF STRATA FROM THE
BLUE MOUNDS
TO THE WISCONSIN RIVER AT
ARENA.

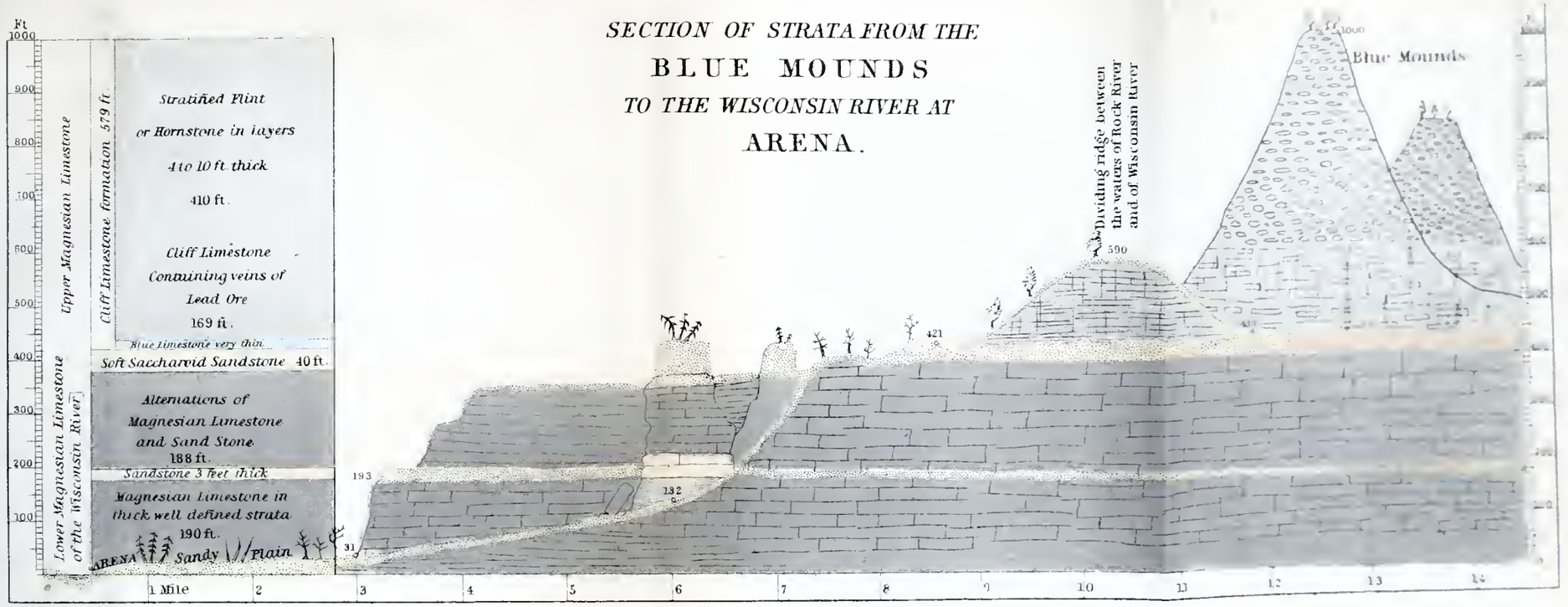
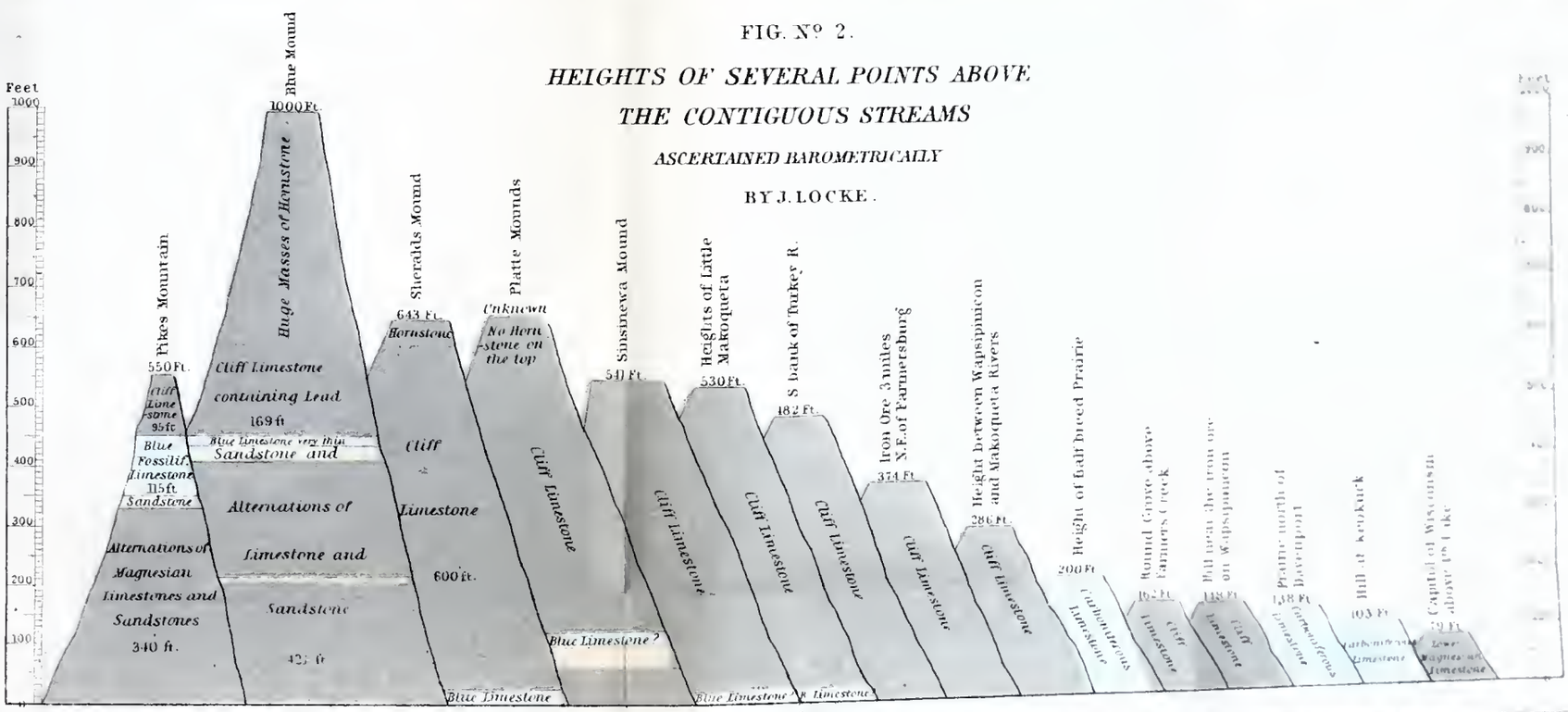


FIG. Nº 2.

HEIGHTS OF SEVERAL POINTS ABOVE
THE CONTIGUOUS STREAMS

ASCERTAINED BAROMETRICALLY

BY J. LOCKE.



Section No. 3.—From the Blue Mounds to the Wisconsin river.

[See plate No. 20, figure No. 1.]

We have here attempted to represent two sections: one seen partly beyond the other. The nearer one is represented in darker shade than the farther one. The nearer and darker one is a section along the valley of two small streams; and the farther one is a section through the mound, and along the ridge or highest part of the bank of those streams. The outline of the darker section is marked by several barometrical stations, as follows:

First, "435." This was the place of encampment, near the head spring of the Peccatonnica river; that number (435) is the altitude above the waters of the Wisconsin at Arena.

Second, "590." This is the dividing ridge between the waters of Rock river and Wisconsin river.

Third, "421." The top of the sandstone.

Fourth, "132." In a deep ravine, the channel of a small tributary to the Wisconsin river.

Fifth, "31." The edge of a sandy plain, extending from the bluffs two and a half miles to the river.

Sixth, "0." The Wisconsin river at Arena.

The town of Arena has a place on the maps, was once a post office, and contained a single log house, which has since been burnt down. I found only the ashes of the log house, an empty cart, and a few suits of "squaw poles," (a nickname for Indian tent poles.) Such *towns* are not uncommon in this region.

Beginning at the top of the Blue Mound, and proceeding downward, this section presents the following strata:

Feet.

I. *Siliceous beds of chert, hornstone*, and other varieties of *flint*, in very large masses. Some of them, I should say, from recollection, were thirty feet long, twenty feet wide, and ten feet thick. They are stratified, and lie almost or quite in contact; but show a disposition to the nodular form, by frequent vertical joints, and being variously interrupted. The structure is often cellular, and the cells lined with small quartz crystals, which give a rough appearance to the masses. Fossils are rather rare in this siliceous portion, but such as were found belonged to the cliff formation. This member of the cliff, which is usually found as a mere included layer of a few inches, is here developed to - - - - - - - - 410

II. *The cliff limestone, including lead ore* - - - - 169

III. *The blue fossilliferous limestone*, very thin, and in some places entirely wanting, or apparently so. I have assigned it no thickness.

IV. *Sandstone.* The same as that described at Prairie du Chien. There is every evidence that this is identical with that on the Mississippi, for it may be traced continuously along the Wisconsin from one point to the other. It is remarkable for having its upper surface at an exact and even plane, very nearly level. In an excavated area, where several ravines meet in the same valley, and with the eye at any point of the upper surface of this sandstone, all other points appear in the same plane like an emptied lake, leaving a line of ice to mark its original height; even where the rock is

covered by earth, the vegetation changes so abruptly in sort and color, at the surface of the sandstone, that the line may still be distinctly traced. In the section which we are describing are represented two outliers, or natural columns, running up to the top of the sandstone, and capped with small pines. The tops of several such outliers, where they occur, will be found to lie in the same exact plane. We have assigned to this stratum the thickness of - 40

Feet.

V. *Alternations of magnesian limestone and sandstones* - 188

I had little opportunity of examining this stratum, and cannot give its characters; it is probably similar to the corresponding layers at Prairie du Chien.

VI. *Sandstone.* Variable, and not well defined - - - 3

VII. *Limestone,* (probably magnesian.) In thick, well-defined strata, very suitable for building, but of rather a dark, ferruginous color. At the edge of the sandy plain "31," it was lying on the hill side in very large tabular masses, two feet thick, and twenty or thirty feet in diameter, with sharp angles and edges; sufficient evidences of integrity, strength, and durability. In external characters, it resembled the harder specimens of the cliff limestone, but was destitute of fossils; in thickness, above water - - - - 190

Total - - - 1,000

The sandy plain of Arena is covered, next to the bluffs, with a forest of small timber. Near the river are several groves of small pines, of a peculiar species; and so constantly does the wind blow from the southwest, that these trees lean with great uniformity about five degrees in the opposite direction. At various places, also, in the open plain, the wind has taken such hold of the sand as to uproot the grass, and, drifting the dried sand continually forward, has formed broad valleys, terminated by a semicircular sand drift, ten or twelve feet high at the northeast end. Through the middle of this drift is a narrow slit. As the sand drift progresses, vegetation is buried and destroyed, and thus prepared to be in time uprooted by the persevering breeze, which, urging the drift forward, by carrying the particles over from the windward and depositing them to the leeward side, finally exposes and excavates the spot which was once most deeply covered.

The sandy stratum (IV) gives rise to the alluvial sands of the Wisconsin, and to those of the Mississippi; indeed, it seems to be nearly or quite destitute of mica or feldspar; and the clear, glassy particles of quartz, of which it is composed, sparkle in the sun like minute brilliants. That the quartz is pure and unmixed; that the angles of the fragments are sharp and unabraded; that the surface of the stratum is an exact plane, like the undisturbed surface of a liquid—are interesting problems for the speculative geologist.

I have thus gone briefly through with the subjects of the *altitudes* and the *sections*, and have incidentally given such *imperfect sketches* of distinctions and external characters of strata as were necessarily observed in a very hasty search for their several boundaries and junctions, while taking their admeasurements; but I have not offered these sketches as in any degree answering as substitutes for the more complete discriminations which may be expected in your report. It is true that a sixty days' labor can but begin such a task as this field offers; but from the numerous spe-

cimens which you have collected, and from your known skill in *analysis*, (that all-important source of valuable knowledge,) I hope you will review and enlarge upon the subjects of which I have here done little more than exhibit their proximate proportions.

III.—THE ALTITUDES OF TABLE LANDS, HILLS, "MOUNDS," AND MOUNTAINS, DETERMINED BY BAROMETRICAL OBSERVATIONS.—WITH A CHART.

[See plate No. 20, figure No. 2.]

In determining altitudes by the barometer, it is important (and almost indispensable, indeed) that there should be simultaneous observations, both at the place the height of which is to be determined, and at some point not very remote, the height of which has been previously ascertained. This becomes the more necessary in a northern latitude, and in the autumnal season, when the changes of a stationary barometer are frequent and rapid. My efforts to obtain a co-laborer, either at Galena or Dubuque, were fruitless; and the observations of Dr. Engelmann, of St. Louis, although accurate in themselves, were at too great a distance. Under these circumstances, my mode of operating was to observe the barometer at some known point of reference, as the surface of the river; and, proceeding with as little loss of time as possible to the height, make my second observation. When this was done in a few minutes, the proximate height was presumed to be deducible from the results; but if, from the time or other circumstances, an atmospheric change of the barometer was suspected, the instrument was taken back to the first station, the point determined, and an equation made according to the result. When the distance from the height to the station to which it was to be referred was several miles, then intermediate stations were established, and the observations repeated both going and returning, noting accurately the time by a chronometer. This last method was taken to determine the height of Blue Mound above the Wisconsin river. The distance is about fourteen miles. Starting from my camp at the head of the Peccatonnica, at the foot of the mound, early in the day, I observed the barometer every hour upon my journey, until, in four hours, I had reached the river, and suspended the instrument close to the water's edge. I then returned by the same route, and repeated the observations at the same stations. This would have indicated any progressive change, and pretty nearly its hourly rate. As it happened in that case, the change, if any, was very small; and I obtained not only the altitude of my camp, but of three intermediate points. These stations and their altitudes are marked on the "section of the strata from the Blue Mounds to the Wisconsin river," at the figures "435," (the encampment,) "421," "132," and "31." After all, there were several heights which, for the want of a stationary observer, I was unable to determine; that of the Platte Mounds was one of them.

The accompanying table, or chart, scarcely needs an explanation. I have placed them in the order of their height, and this happens to be nearly in the order of their latitude; the elevations becoming greater in proceeding northwardly. The geological distinctions marked upon the diagram serve to afford to the eye a direct comparison of separate and local observations, as between Pike's mountain and Blue Mounds, where it appears that the corresponding strata, cliff limestone, blue limestone, and sandstone, each occupies a higher place in the latter than in the former, even supposing the

points of reference to be level; which they are not, by the fall of the Wisconsin, from Arena to its mouth, rendering the difference still greater. Thus is furnished important evidence in reference to the dip of strata, that it is, partly at least, westward; other evidence showing that it is also southward, we are led to the conclusion that it is between south and west.

A remark on the Western use of the term "mound."

It was first very properly applied to the numerous artificial tumuli of a conic or flattened hemispheric figure, which abound more or less in every part of the region west of the Allegany mountains. It seems that in the "far West" the term has been promoted to the office of representing isolated natural elevations of a conical form, which, emerging from the elevated prairies of Wisconsin and Iowa, rise above the general table of the country to the height of two hundred, to four hundred, or even to six hundred feet; and, as appears in this table of altitudes, one thousand feet above the contiguous streams. They are certainly seen at the distance of forty miles; and rising, as they do, from the monotonous line of the prairie, like distant islands seen on the ocean, they are perpetually calling back the wandering eyes of the traveller, who sees them sink as he recedes, rise as he approaches, change their apparent position as he insensibly winds his course, or vary their hues or dim distance as the atmosphere drops or dissolves its mistiness.

Deceived by the term "mound," which should be *mountain*, some writer has denominated them "interesting antiquities." To be sure they are antiquities, dating as far back as the "transition" or "secondary" epoch of the creation.

IV.—MAGNETISM.

Popular elementary definitions.

[See plate No. 21.]

The elements of terrestrial magnetism consist simply of the *force, power*, or *intensity*, with which the earth attracts the magnetized needle, and of the *direction* in which that force acts; but, from the vast importance of the horizontal or compass needle, both in navigation and surveying, and from the facility of suspending and experimenting with the same, it is customary to estimate certain elements of the needle in that position, although it is seldom the direction (never in our latitude) in which, if allowed to move freely in all directions, it would place itself. The quantities sought to be measured are usually four:

First. The declination, "variation," or direction of the horizontal needle, as it respects the true astronomical north or south points.

Second. The force, or *intensity* with which the horizontal needle is attracted by the earth, and held in its direction: this is called the *horizontal intensity*.

Third. The *dip*, or true course in which a needle, perfectly free to move in all directions, would finally rest and be held by the earth's attraction.

Fourth. The force or *intensity* with which the needle, in the direction of the dip, is attracted by the earth: this is called the *total intensity*.*

* To avoid a circumlocution of language, the earth's attraction is named without expressing particularly the mutual attraction between the earth and needle.

PLATE N° 71

MAGNETICAL CHART

EXHIBITING THE OBSERVATIONS MADE BY

J. LOCKE DURING THE SURVEY OF THE

MINES OF THE UNITED STATES

BY D. D. OWEN

1839

CHARACTERS

The result located

Encampments numbered 1 2 3 &c

Dip The angle which the magnetic needle makes with the horizon.

H The horizontal force of the magnet that at Louisville K° being 81

T The total force of the magnet

L The variation of the magnetic needle

Lines of equal dip.

Longitude West 90 from Greenwich

Dip 72° 40'

Wisconsin River

Dip 73° 20'

Dip 73° 00

Dip 73° 40'

Dip 73° 20

Dip 73° 00

Dip 73° 40

Dip 72° 40

Dip 72° 20

Dip 73° 30

Dip 72° 20

Dip 72° 00

Dip 73° 00

Iron Ore and Magnetical Mode of Local attraction

Rapidpuncon River

Rock River

PLATTEVILLE

WISCONSIN

FAYETTE

BUCHANAN

DELAWARE

DUBUQUE

ILLINOIS

WINNEBAGO

JO DAVIESS

JONES

JACKSON

LINN

IOWA

CLINTON

OGLE

CEDAR

WHITESIDE

JOHNSON

SCOTT

MUSCATINE

ROCK ISLAND

HENRY

PUTNAM

Fourth. The force or *intensity* with which the needle, in the direction of the dip, is attracted by the earth: this is called the *total intensity*.*

* To avoid a circumlocution of language, the earth's attraction is named without expressing particularly the mutual attraction between the earth and needle.

Magnetical declination or variation.

Most persons are aware that the compass needle does not every where point to the true north, but varies in its direction in different places on the earth's surface, in such a manner that it rather points east of it, directly towards it, or west of it. The force with which the earth attracts or pulls such a needle, so as to hold it in its direction, and cause it to *vibrate* if it be moved out of that direction and be suffered freely to return, is called the horizontal intensity, and is measured by the quickness of the vibrations. Thus, when there are a greater number of vibrations of the same needle, in the same time, the horizontal intensity is greater, being as the squares of the numbers of such vibrations. A vibrating needle used for determining the intensity, is a "magnetical pendulum," acted upon by magnetism as a clock pendulum is by gravitation.

Magnetical dip.

Make a needle of tempered steel, with pivots at the sides, so that it can turn like a cannon, and point up or down; balance it so nicely that it will stay in any position in which you place it: this must be done while the steel has no magnetism. Next, magnetize that needle by "touching" it with other magnets, as directed in the books on magnetism. Lastly, place the pivots in proper supports, exactly crosswise of the line in which the compass needle points: it will no longer remain balanced, especially in the horizontal position, but, in the latitude of the United states, the north end will turn down, nearer to a perpendicular than to a level. This turning down, or out of the level, is called the *dip;* it is measured by the number of degrees which the north end descends from a level line. The dip increases as we travel northward, until at a point north of the western part of Hudson's bay, where it points directly downward. At or near the equator there is no dip, or the dipping needle lies level; and south of that point, the south end of the needle descends, as does the north end in the northern hemisphere.

Now, whatever direction the dipping needle takes, it is held there by a magnetical force of the earth, which, when it is moved out of that direction, draws it back again, and causes it to vibrate like a pendulum, and, finally, to settle at the proper dip. If the force be greater, the vibrations will be quicker; this force is called the *total intensity*, and is not usually ascertained by the vibrations of the dipping needle, but is deduced by calculations from the horizontal intensity, and the dip, at any locality. This force, on the whole, increases as we proceed northwardly; but the horizontal intensity, in consequence of the increase of the dip, diminishes in the same direction. At the magnetic pole, where the dip would be 90 degrees, (viz: the dipping needle perpendicular,) the horizontal intensity would be nothing, and the common compass needle would point in one direction as soon as in another—the magnetical force of the earth pulling it, at all points, directly downward upon the supporting pivot.

Now, to measure these four quantities, in different localities, as accurately as possible, has been a part of my labors in the late brief survey of a part of our territories; and to communicate the result is the object of the present article.

Some sorts of iron ores have an influence on the magnetical needle, and change either its direction or its intensity. The effect of such ore increases directly as the quantity or mass, and diminishes as the squares of the dis-

tances increase; and although the mass may be large, yet, from the effect of depth or distance, the indication may be too slight to be observed, unless by the most delicate instruments, skilfully used. By means of these, we may be guided to vast mineralogical treasures; for, however desirous we may be to discover gold and silver mines, iron is the more useful metal. We have discovered, in Iowa, one magnetical node, which may be produced by a "*subterraneous* iron mountain; but of this, more hereafter. Independently, however, of any economical views, it will be a matter of gratification to the scientific world to receive a small contribution to their fund of magnetical knowledge; for an effort is now making to collect and imbody as many accurate magnetical observations as possible, in order the more fully to determine the changes, distributions, and general laws of this wonderful force, and to make it still more subservient to the purposes of general utility.

A very interesting report on the subject of magnetical observations has lately been made to the Royal Society, by Sir J. F. W. Herschell. Upon the approval of that report by the society, a deputation was requested to communicate certain resolutions to Lord Melbourne, and to urge on the Government the adoption of the measures therein proposed. "This," says the editor of the Journal of the Franklin Institute, "has produced its desired effect upon Her Majesty's ministers, who have appointed three officers of artillery, with adequate attendants, to go, respectively, to Montreal, to the Cape of Good Hope, and to St. Helena, to make experiments on the variations and dip of the needle, and the intensity of magnetism, frequently and simultaneously, each day, for three years," &c.—[See table.]

Instruments used in making the magnetical observations.

The DIP was observed by a dipping compass made in 1837 by Robinson of London, on a plan similar to that upon which he has constructed them for Captain Ross, nephew of Sir James Ross, and for several other experienced observers; two needles were used at each station, and reversals made, both of the face of the instrument, the face of the needle, and of the polarity of the needle, by "retouching" upon the field with two magnetic bars. This mode of operating requires eight annotations of the dip with each needle—sixteen in all; and the results given in this report are, in almost every case, the mean of the sixteen. So well did the instrument perform, that the separate results of each needle differed not more than a minute from each other. The following is a copy from my field book of the observations to determine the dip at Mineral Point, Wisconsin, on November 5th, commencing at 9 A. M:

NEEDLE No. 1—*B North.*—	E. E.	74°	30.0′
	W. W.	72	10.5
	W. E.	74	22.0
	E. W.	72	22.5
A North.—	E. E.	72	31.5
	W. W.	74	10.0
	W. E.	72	12.5
	E. W.	74	26.5
	8)586		45.5
Mean for No. 1 =		73	20.6875

NEEDLE No. 2—*A North.*—E. E.	73°	26.5′
W. W.	73	9.0
W. E.	73	18.5
E. W.	73	12.5
B North.—E. E.	73	33.5
W. W.	73	15.0
W. E.	73	27.5
E. W.	73	21.5
8)586		44.0
Mean for No. 2 =	73	20.5

Here it will be observed, that, although needle No. 1 is unbalanced, and reads very wide of the mean on both sides, yet the errors are all merged by the reversals; and the mean by each needle does not differ from the mean of the whole the tenth part of the minute of a degree.

Mean by No. 1.—	73°	20.6875
Mean by No. 2.—	73	20.5000
2)		41.1875
Total mean,	73	20.59375
Difference,		0.09375 minute.

The HORIZONTAL INTENSITY was determined by vibrating three needles* successively in a glass vessel exhausted, as near as possible, by a small air pump, and noting the time required for five hundred vibrations by a chronometer, and the temperature by an included thermometer. The degree of exhaustion indicated by the mercurial gauge was from five-tenths to seven-tenths of an inch. The initial arc of vibration of each needle was about seven degrees on each side of the meridian, and the terminal arc a little over one degree. This apparatus for vibrating the needle, to determine the horizontal intensity, was invented by A. D. Bache, president of Girard College. The final reduction for temperature, and the calculations for obtaining the numerical expressions for the horizontal and total intensities, were made according to the usual rules laid down for that purpose. (See President Bache's papers in the Transactions of the American Philosophical Society.) The numbers are, however, merely comparative, and have been referred to *Louisville*, Kentucky; the horizontal intensity of which, as taken at Corn island, has been assumed as unity, or rather as ten. It was intended to have compared the intensities with those taken at Cincinnati; but it was found, from some cause or other, that the separate results obtained there by the three needles were *discordant*, while at every other station they agreed very nearly. I hope soon to be able to connect this group of observations with those made at Philadelphia, and thus make them comparable with the extended results obtained by the philosophers of that city and of foreign countries, It is true, I vibrated the identical needles used on this survey at the *Greenwich observatory* in 1837, and

* Two of these were of the form and size recommended by Hansteen; and the third was a flat bar, with lozenge terminations.

obtained a comparison between the vibration there and at Cincinnati; by which it appeared that the horizontal intensity at the former place was, to the horizontal intensity at the latter place, as 1000 is to 1163.6; but the needles were new, the observation with each needle only once performed, and myself but little experienced in the manipulations.

The VARIATION was observed by me with an apparatus in no way superior to that used by our land surveyors. The few observations which I made correspond remarkably well with the returns of those surveyors. The accompanying "variation chart" exhibits the variation at which the township lines have actually been run. It was compiled at the land office at Dubuque, from the field notes, and kindly forwarded to me by my friend E. Dwelle, first clerk in that office.

By the chart exhibiting the dip and intensities, it appears that the dip does not increase regularly, or by an equal number of minutes, to an equal number of miles of north latitude. From St. Louis to Mineral Point the average increase is one minute of dip to 1.28 mile, or a little more than one mile and a fourth of a mile; but from Davenport towards Prairie du Chien, where the observations are sufficiently near to each other to exhibit local fluctuations, they are made very evident. From Davenport, northwardly, about thirty miles, it increases with great rapidity; after which, it actually diminishes. It then increases rapidly to Dubuque. From Dubuque to Prairie du Chien, the increase is very moderate; so much so that the interval from 73° to 73° 20′ is more than twice as great as the interval required for the previous increase of 20 minutes.

The LINES OF EQUAL DIP traced on the chart do not imply any great precision or exactitude. After the chart was filled up with the precise points of encampments, and the exact dip observed at those points, these lines were drawn with a free hand, so as to include, between any two contiguous ones, all those observations limited by 20 minutes. Proportional points were often taken in a line between two observations, and the lines of equal dip projected through them. These conditions of their consistency with the observations made it necessary that some of them should be curved much more abruptly than the projections of great circles. Towards the northeast part of the map, it will be seen that the lines of equal dip incline, in proceeding eastward, very much to the south; or, in other words, the dip increases in travelling eastward, as well as northward. This is remarkably evident in the journey from Prairie du Chien to Madison, nearly due east; and yet the dip increases four-fifths of a degree.

On reviewing the chart, it appears to me, from the few observations I was enabled to make with reference to the localities of iron ores, that the rapid increase of the dip over certain regions, as between Davenport and Dubuque, and again between Prairie du Chien and Madison, corresponds to an increased quantity of iron in those regions. But this is a point which can much better be determined by yourself; as, by the numerous specimens brought to you from every part of the surveyed region, you will be able precisely to point out the ferruginous tracts.

Magnetical node.

The most remarkable magnetical phenomenon developed by this survey is a point of local attraction on the river *Wapsipinecon*, nearly in the centre of the great bend of the *Mississippi* river, from Dubuque

to Davenport. At this place all the elements of magnetism are suddenly changed; the variation, the dip, the horizontal and total intensity, are all peculiar; the dip and total intensity are greatly increased, while the east variation and the horizontal intensity are diminished. On three different sides, the dip is less than at this point; thus it would seem there is a local point of dip, a magnetical island, not connecting itself by any line of equal dip with any other points; the *proper line* of 72° 50′ being about twenty-eight miles to the north of this place. At this point on the *Wapsipinecon* river was found abundance of iron ore, especially the hematite, which is a peroxide of iron, and does not in small masses affect the magnet; we found also detached masses of iron ore, not only magnetic, but actually magnetized, having permanent polarity, and being *proper loadstone.* These were, however, too inconsiderable in mass, of themselves, to have produced the magnetical disturbance occurring here; there is probably, at an unknown depth, a mass of magnetic iron ore in this place—a *subterranean* "iron mountain" like those in Missouri; it may lie too deep for exploration. A more particular magnetical survey might determine more precisely its axis, and point out the exact place for boring, or for sinking a shaft, with the hope of reaching the ore in place.

Dip and intensity in the lead mines of Dubuque.

As the lead appears to be mostly associated with ferruginous clays, and not unfrequently to lie in contact with thin veins of hydrated peroxide of iron, I was desirous of making observations in the midst of a vein of lead ore, in order to see whether any effect would be produced by the contiguous minerals. After having observed the elements of the dip and intensity at the promontory of Dubuque's grave, I descended one hundred feet into the mine of Mr. Dougherty, (who kindly afforded every facility,) and there repeated the observations; the results were identical with those of the former one, the metallic vein appearing to exert no peculiar magnetical influence.

It appears, by both the table and chart, that the total intensity increases in travelling towards the north, or, more properly, in the direction of north several degrees east—being least at St. Louis, and greatest at Madison, in Wisconsin; the progression is not uniform from one of these points to the other, but undergoes several undulations. The intensity at St. Louis (29.366) is to that at Madison (30.433) as 1000 to 1036.6. The magnetic elements of direction and intensity are undergoing a slow and progressive change, and are also subject to annual and daily oscillations, taking place at particular seasons of the year, and at particular hours of the day. Besides these fluctuations, which have been ascertained and can be predicted, late experiments show that there are irregular fluctuations of small amount, which cannot as yet be foretold. In the foregoing observations and calculations, these varying quantities have not been taken into account.

In 1819, it was ascertained by Major Long's party that the dip at St. Louis was 70° 30′; it is now (1839) 69° 31′; showing a mean annual *diminution* of 3′ 3″.

It will be seen, by the chart of variation, that the direction of the needle, as returned by the surveyors, undergoes numerous irregular changes, the effect of "*local attractions.*" I had doubted the correctness of their ob

servations, but I am fully convinced that these changes are at least as great as they represent them. Part of the region traversed had been surveyed by Mr. Burt, with his solar or equatorial compass—an ingenious contrivance, which measures constantly the sun's azimuth, and indicates the variation at any time of the day, during clear weather, by a solar spectrum; this presumes the latitude and sun's declination to be known, and the instrument to be adjusted accordingly.

I have already anticipated one of the uses to which a knowledge of the elements of terrestrial magnetism may be applied, viz: the discovery of some species of iron orres. It remains to make a few observations on a proposition which has been agitated for two years before the Congress of the United Stntes, viz: to use the elements of magnetism as the means of determining the latitude and longitude for nautical and geographical purposes. The agitators of this proposition seem to have taken it for granted that the magnetical lines, meridians, equators, poles, &c., bear the same relation to the terrestrial lines and points of the same name, as the ecliptic and its secondaries bear to them; being that of two concentrical spheres, whose axes cross each other at an angle of 23° 28′. This should have been called a *theory*, not a "*discovery;*" for it contradicts, directly, well-observed facts, and disagrees with the observations recorded in this paper. Should Congress see fit to send the projector of this theory, or any qualified person, abroad to make magnetical observations, and make an appropriation for that purpose, it would meet the approbation of the learned throughout the world. But, that a splendid speculation should be agitated by persons who, however well qualified as men of literature and as politicians, are not adepts in the modern science of magnetism and electrology—that an amount of national treasure sufficient to have erected a magnetical observatory should have been spent on a project which every magnetician in the country foresaw was absurd—are subjects much to be regretted, and are calculated rather to injure our national reputation for physical science. On this subject, I concur fully in the sentiments of Dr. Patterson and Mr. Walker, published in the Proceedings of the American Philosophical Society, for July and August, 1838.

I may be called upon to specify what I have charged in general terms; there is no end to words, and this is no place to go into a long argument.

It is asserted in that theory, that "the line of no variation is a great circle of the earth." Those who have actually surveyed that line, report it as being very irregular, and not a great circle. The *lines of equal variation*, as observed and reported in the returns of the surveyors of western parts of the United States, proceed southwardly, and curve rapidly to the west. If, as observations seem to indicate, the elements of magnetism are subject to all of the changes previously named, being affected by progressive changes, by summer and winter, by day and night; and, also, like the barometer, by irregular, unforeseen causes; they will, for the present, scarcely answer as a substitute for astronomical observations in determining geographical position.

Table of the magnetical observations and calculations made during the survey of the mineral lands.

No. of station.	Place of observation.	Time.	Latitude north.	Longitude west of Greenwich.	Magnetical dip.	Horizontal intensity—that at Louisville being 10.	Total intensity.	Variation observed by myself.	Variation recorded by surveyors.
		1839.							
1	Cincinnati	Aug. 29	39° 6′ 11″	85° 30′	70° 8′	10.000	29.427		
2	Louisville	31	38 3						
3	St. Louis	Sept. 5	38 36	90 2 15″	69 31 4″	10.266	29.366		
4	Louisiana, Missouri	8	39 22 36	90 50	69 51 8				
5	Marion city	9	39 44	90 14	70 20 9				
6	Montrose, Iowa	11	40 19	90 14	70 54 3				
7	Davenport	13	41 30	90 18 30	71 55	9.226	29.725	8° 36′ E.	7° 50′ E.
8	Lost Grove	23	41 39 30	90 9	72 2 4	9.206	29.845	–	8 10 E.
9	Wapsipineeon river	25	41 44 36	90 23	72 15	9.1067	29.854	8 25 E.	8 20 E.
10	Iron ore	27	41 55	90 40 23	72 50	8.9115	30.197	7 5 E.	8 20 E.
11	Elkford	29	42	90 52	–	–	–	–	9 15 E.
12	Small mill	30	42 4	91 2	72 24 4	8.985	29.635	9 4	9 10 E.
13	Bridge	Oct. 1	42 6	91 2	–	–	–	–	9 20
14	Makoqueta river	1	42 14	90 57	72 44	8.867	29.664	–	8 45
15	Mill	2	42 10	90 37	–	–	–	–	9 15
16	Cheney's	3	42 12	90 2046	–	–	–	–	9 5
17	Farmer's creek	5	42 12 40	90 23	72 36	8.982	30.035	9 11	9 5
18	Whitewater	8	42 18	90 38	72 55 5	8.775	29.885	–	9 10
19	Near the same	8	42 19	90 39	–	–	–	–	9 10
20	N. braneh Makoqueta	9	42 22 40	90 52	72 51	8.733	29.616	–	9 35
21	Sherwood's	11	42 27	90 37	73 7	–	–	–	9
22	Dubuque	14	42 29	90 23	73 5	8.638	29.686	–	8 22
23	Little Makoqueta	20	42 31	90 31	73 8	8.599	29.639	–	8 30
24	Sherald's Mound	21	42 35	90 33	–	–	–	–	8 10
25	Log house	22	42 38	90 43	–	–	–	–	9
26	Turkey river	23	42 42	90 48	73 11	8.575	29.593	–	9
27	Dr. Andrews's	24							
28	Ferry opp. Prairie du Chien	25	43 1	90 53 30	73 16 8	8.6030	29.91	–	9 5
29	Prairie du Chien	26	43 3	90 52 30					

TABLE—Continued.

No. of station.	Place of observation.	Time.	Latitude north.	Longitude west of Greenwich.	Magnetical dip.	Horizontal intensity—that at Louisville being 10.	Total intensity.	Variation observed by myself	Variation recorded by surveyors.
		1939.							
30	Trout brook - -	27	42° 59′	90° 45′	–	–	–	–	9°
31	Parish's - - -	28	42 58	90 10	–	–	–	–	8 55′
32	Blue Mound - -	29	43 1	89 38	73° 41′	8.420	29.970	–	8 38
33	Madison - - -	Nov. 2	43 5	89 6 30″	74 4 4″	8.356	30.433	–	7 30
34	Campbell's - -	3	43 3	89 25	–	–	–	8° 46′	8 50
35	- - - -	4	43 3	89 42	–	–	–	–	8 20
36	Mineral Point - -	5	42 50	89 54	73 20 6	8.502	29.659	–	8 40
37	Galena - - -	9	42 22	90 10 23	–	–	–	–	9 25
	Cincinnati, 1840 - -	Jan. 11	39 6	84 29	70 29 4	9.765	29.241	4 46	
	Greenwich, (England,) 1837	Aug. 26	51 28 39″	0 0 0	69 23 4	8.112	23.047	–	24 0W. in 1831.

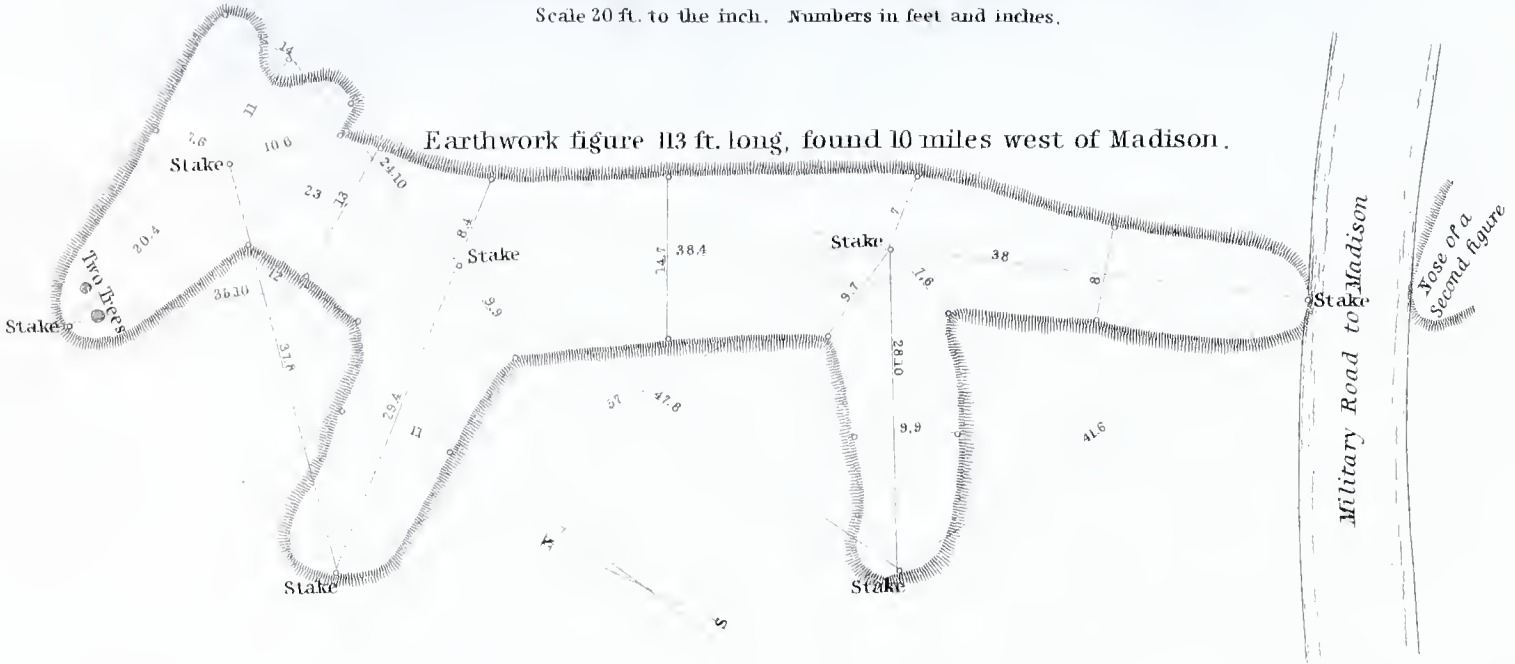
The hours of observation were generally from 8 to 12, A. M. The latitudes are mere approximations, assuming the north line of Illinois to be 42° 30′, and calculating from that line by the surveys into townships and sections. The longitudes have been calculated in the same way, assuming that of Prairie du Chien, Fort Crawford, to be 90° 52′ west of Greenwich, as determined by Lieutenant Calhoun, in Major Long's expedition.

PLATE Nº 22.

EARTHWORK ANTIQUITIES OF WISCONSIN

SHOWING THE MANNER IN WHICH THE FIGURES WERE SURVEYED AND DRAWN.

Scale 20 ft. to the inch. Numbers in feet and inches.



V.—EARTHWORK ANTIQUITIES IN WISCONSIN TERRITORY.

[See plate No. 22.]

I present this subject, not as a discovery, but merely to add such evidence to the discoveries and publications of others as seem, from the doubts I have heard so repeatedly expressed, to be necessary to convince the majority of readers of their correctness. In the 34th volume of "Silliman's Journal" is a communication from Richard C. Taylor, Esq., on the subject of these identical works, in which he describes them as being "in the form of animal effigies." The figures given by Mr. Taylor are so unlike any ancient tumuli in other parts of the country, that I had, ever since noticing them, felt a strong desire to examine the originals. On entering Wisconsin, I was so engaged in other pursuits that I had forgotten the "effigies," until, upon examining the "sandstone bluffs," eight miles east of the Blue Mounds, I literally stumbled over one of them, overgrown with the rank prairie grass. I was at once convinced of the correctness of Mr. Taylor's representations, and not a little astonished that some well-informed persons there, in the midst of these strange groups, should still pretend to dispute their artificial origin. The same ambition to exercise an independent judgment might lead the same individuals to dispute that the ruins of Herculaneum are artificial; the same argument might be used—"that they just come so in the earth." Without going into any discussion in regard to the origin, history, or design of these figures, I shall merely represent their form and dimensions with as much accuracy as a very particular survey of a few of them enabled me to attain. I shall not even pretend to say that they are like animals; for this the reader can determine for himself. I have not attempted, in any degree, to represent them *as they might once have been*, but exactly as I found them on the day that I surveyed them.

The method pursued in making the surveys is represented in *plate No. 22, Antiquities.* Here, for convenience, I make use of the names of the parts of an animal. The figure delineated is the foremost one of two, between which the road passes, and which are on the verge of a small prairie, about ten miles west of Madison, the capital of Wisconsin. Small stakes were set in the following points, viz: the eye, the fore foot, the shoulder, the hip, the hind foot, and the end of the tail. The angular positions of these and other points were determined by measuring, with a tape measure, the sides of the several triangles which those points form, in such a manner that the determined side of one triangle shall be the base of a new one. After the determination of all the triangles, their several diameters and distances were measured and noted; and, finally, to determine the bearing of the whole figure, the magnetical bearing of the line from the hip to the shoulder was registered on the field book.

The following is a copy from the field notes, in reference to the above figures. (*See Antiquities, plate No. 22.*)

Triangles.	Feet.	Inches.
Eye to shoulder	23	0
Shoulder to foot	29	4
Fore foot to eye	37	8
Eye to nose	20	4
Nose to shoulder	35	10
Eye to point half way between the ears	11	0
Shoulder to same point	24	10
Shoulder to hip	38	4

	Feet.	Inches.
Fore foot to hip	57	0
Shoulder to hind foot	47	8
Hind foot to hip	28	10
Hip to the tip of the tail	38	0
Hind foot to the tip of the tail	41	6

Diameters.

	Feet.	Inches.
Of the neck	13	0
Of the fore leg	11	0
Of the body	14	7
Of the hind leg	9	9
Of the tail	8	0

Distances.

	Feet.	Inches.
From the eye to the front	7	6
From one ear to the other	14	0
From shoulder to armpit	9	9
From shoulder to back	8	4
From hip to rump	7	0
From hip to flank	9	7
From hip to insertion of the tail	7	6
Length of the throat	12	0

Observations.—Ears distinctly separated. Two trees, sixteen inches in diameter, growing in the nose. Ground sloping gently towards the feet. Both the fore and hind legs curved a little backwards. The tail a little hollowed on the upper side. Height, or relief of the figure above the natural surface, about three feet; and the back somewhat steeper than the belly. Bearing of hip to shoulder, N. 38° W.

It will be seen, by examining the above notes, that they determine twenty-five points in the circumference of the figure; and that the connecting of these points by lines, and thus completing the outline, permits no exercise of imagination. The figure from the earth is simply transferred to the paper on a scale of the one hundred and twentieth part, in linear dimensions. Seven other figures were surveyed with the same degree of particularity, and the distances between them, and the relative positions of the same group, accurately noted. They are represented in the three following plates, on a smaller scale of forty feet to the inch. That which is above described, and represented on plate No. 22, is again represented on the small scale, "*Plate No. 25, Antiquities,*" as figure 8.

The "military road" from Prairie du Chien to the Four Lakes, after crossing the Wisconsin river, and ascending a small tributary, occupies the height or dividing ridge between the waters of the Wisconsin on one side, and those of Rock river and some smaller streams on the other, for the distance of eighty or one hundred miles, occasionally descending into a moderate valley, and crossing a small rivulet, a head branch of some of the incipient streams. Most of the route is on a high open prairie. From the Blue Mounds eastward to the Four Lakes, the country abounds with the earth-work antiquities, of the origin of which the present aborigines are as ignorant as ourselves. About seven or eight miles eastward from the Blue Mounds, the road descends into the valley of a head branch of *Sugar* river, a tributary of Rock river; and here, near a bluff of sandstone of a very picturesque and fantastic outline, commence our particular descriptions.

Antiquities, plate No. 23.—This plate represents a group of works about eight miles east of the Blue Mounds. It is on the great road from Prairie

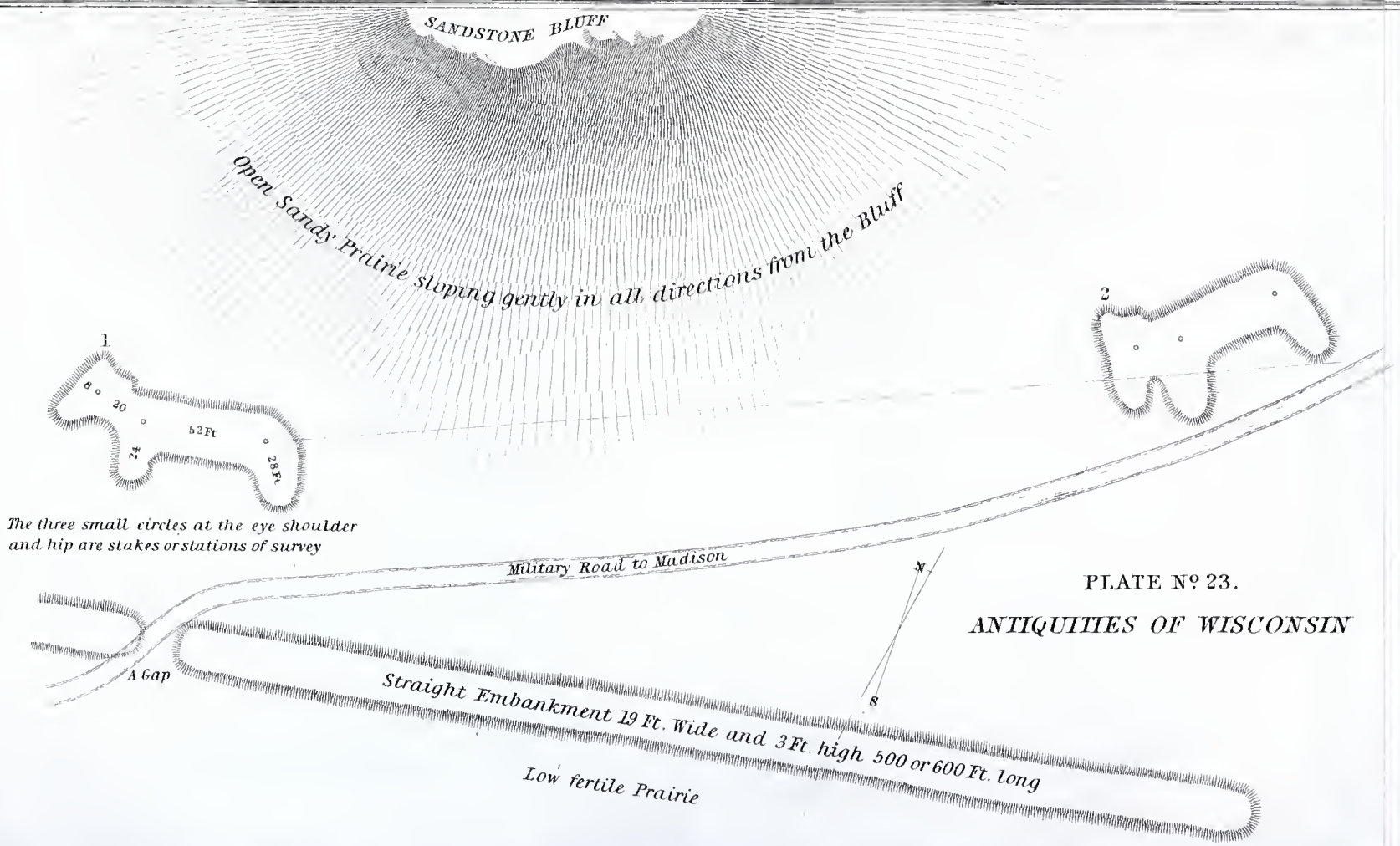

SANDSTONE BLUFF
Open Sandy Prairie sloping gently in all directions from the Bluff
1
8
20
52 Ft
24
28 Ft
2
The three small circles at the eye shoulder and hip are stakes or stations of survey
Military Road to Madison
N
PLATE Nº 23.
ANTIQUITIES OF WISCONSIN
A Gap
Straight Embankment 19 Ft. Wide and 3 Ft. high 500 or 600 Ft. long
8
Low fertile Prairie

PLATE №19. FIG. №1

GEOLOGICAL SECTION FROM THE

SOUTH FORK OF LITTLE MAROQUETA,

THROUGH DUBUQUE,

TO SINSINEWA MOUND

BY J. LOCKE

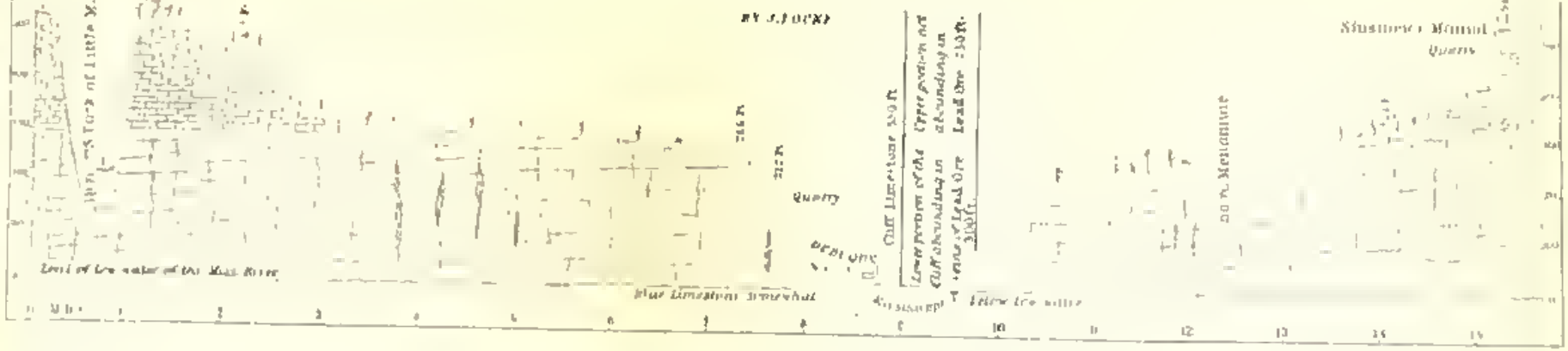


FIG №2.

SECTION OF THE VALLEY OF THE

MISSISSIPPI RIVER

AT PRAIRIE DU CHIEN

BY JOHN LOCKE

du Chien, through Madison, to Lake Michigan; a road so decidedly marked by nature, that I presume it has been the thoroughfare—the "trail," the great "war path"—ever since the region in the vicinity has been inhabited by migrating man, and will continue to be his pathway untill the hills and the rivers exchange their places. The sand bluff surmounted with pines is here a picturesque object; and the streamlet and springs not very distant, with a few scattering trees for fire, have long made it a camping ground. Mr. Taylor has represented only one of the two "effigies" which occur at this point; the other was probably so overgrown with grass and small hazel bushes as to escape his observation. Our encampment was near this place; and, in the midst of some discussion with regard to the tumuli, they were opened, to see whether they were stratified, and whether the black mould continued underneath them, even with the surrounding surface. No. 2 was composed of sand, without any change to mark an original surface below, although it is now overgrown with grass, and is covered with a thin black mould. The whole of this descent, near the bottom of which the figure lies, has evidently been formed by the disintegration of the soft incoherent sandstone bluff contiguous; and, at the time of forming this tumulus, it was very probably destitute of loam at this point, as it now is at a point still nearer the bluff. A section of the embankment, near the gap, exhibited a thin line of loam, even with what might be supposed to have been the original surface of the ground. Alluvial stratification is positive proof that a formation is not artificial, but the absence of a base of mould is not positive proof of the same thing; for the constructors may have removed the surface on commencing their work. Many of our tumuli have not only a base of mould marking an original surface, but ashes, coals, bones, and artificial implements deposited at the bases of tumuli, of various forms and heights, from two to seventy feet.

In examining the tumuli of Wisconsin, I did not at any place discover a ditch or cavity from which the earth to construct them had been taken. They abound along the natural road, occupying the fertile and commanding hill tops and the gentle slopes into the valleys; being uniformly raised from a smooth and well-formed surface, always above inundation, and well guarded from the little temporary currents produced by showers.

The backs of the "effigies" were uniformly placed up-hill, and the feet downward, as at the sand bluff. There are some points on the surface of soft ground, where we naturally expect chasms, rugæ, mammillary points, and undulations. These occur from the uprooting of trees, from avalanches, from the settling of banks, from the action of temporary streams and currents of water. Mammillary points are often left along the sharp crest of a hill; and insular mounds are not unfrequently left in low alluvial bottoms; certain points of upland having withstood that action of the currents which has carried away and degraded the surrounding surface to a lower level. But there are other situations where we expect to find, and do actually find, the surface evenly graded into smooth undulations, as on the dividing tables between the heads of streams, and in the tops of moderate hills, where no current has room to accumulate; and especially if the same region be prairie, with the surface protected by the strong roots of wild grasses.

Just such a situation is this part of Wisconsin, where the geologist suddenly and unexpectedly meets with these groups of gigantic basso-relievos, which appear to him as decidedly artificial as the head of Julius Cæsar on an ancient coin, notwithstanding any thing which may be imagined or said to the contrary.

Antiquities, plate No. 24.—The first or left-hand figure on this plate (marked 3) is about one mile and a half from the bluff above described. It appears to be solitary; lies on a low, level, smooth ground, and seems to have been mutilated; the parts which I have called the legs seem to have been partially washed away. If intended to represent an animal, the head is evidently too large, and the attitude very stiff and rectangular. But I have drawn it as I found it, without any inclination to make it more like an animal than it was made in the original design, with all of the defacements which several hundred years have imprinted. The distance from this third figure to the next group is diminished on the plate. It is really one-fourth to one-third of a mile, where, on our progress towards Madison, we approach the termination of the valley in which our figures, so far, have been sketched. Here, upon the side of a hill sloping gently toward the road, are three figures and an embankment; the sizes, distances, and relative positions of which have all been drawn to a uniform scale of forty feet to the inch.

Antiquities, plate 25.—Leaving the group last described, and proceeding still eastwardly towards the Four Lakes, we ascend a ridge, and pass out of the valley containing the six figures represented on plates 2 and 3. The road for about two miles lies over broken, thinly-timbered ridges; beyond which it crosses a small prairie, and again enters woodland. Just at the entrance of this woodland are the two figures sketched on the plate, and numbered 7 and 8. The pathway passes, with scanty space, between the nose of the one and the tail of the other. These, as appears in the drawings, are the most perfect, if we consider them as "effigies" of animals, of any of the figures here represented, and are singularly alike in their form and dimensions. A short distance (500 or 600 feet) to the west of them is a natural swell of ground, with an artificial circular tumulus on the top of it, overlooking the two figures.

If these figures were originally intended to represent animals, they might have been much more distinct and specific than they now are. It is obvious that any minute delineations must soon be obliterated by the agency of the weather. Most of them have the upper part of the head, the ears, or antlers, apparently too large—at least it appears so in the drawings. But this part, in the originals, is not raised from the ground so high as the other parts, and appears like several small parts trodden down and blended together. In the eighth figure, especially, there is a decided notch or separation still remaining between the two horns or ears. They are the favorite resort of badgers, who, finding them raised and dry, have selected them for burrowing; and it is wonderful that they retain their outlines so perfectly. But, above all other creatures, civilized man will obliterate them the most speedily; and it is much to be regretted that the multitude of extraordinary figures, raised like embossed ornaments over the whole of this part of the country, could not be accurately measured and delineated before they shall be obliterated forever. The reader will please to observe that these observations were made, as it were, by stealth. I had other duties to perform, and was enabled to take these measurements by an enthusiasm which awoke me in my tent at midnight, assisted me to prepare my breakfast before day, and sent me into the cold bleak fields on a November morning, to finish the admeasurements of a whole group of figures, before the usual time of commencing the labors of the day. I had no time to turn aside to examine still other groups, evidently more extensive and interesting than those which we have endeavored to represent.

PLATE Nº 25.

ANTIQUITIES OF WISCONSIN

Scale 80 ft. to the inch

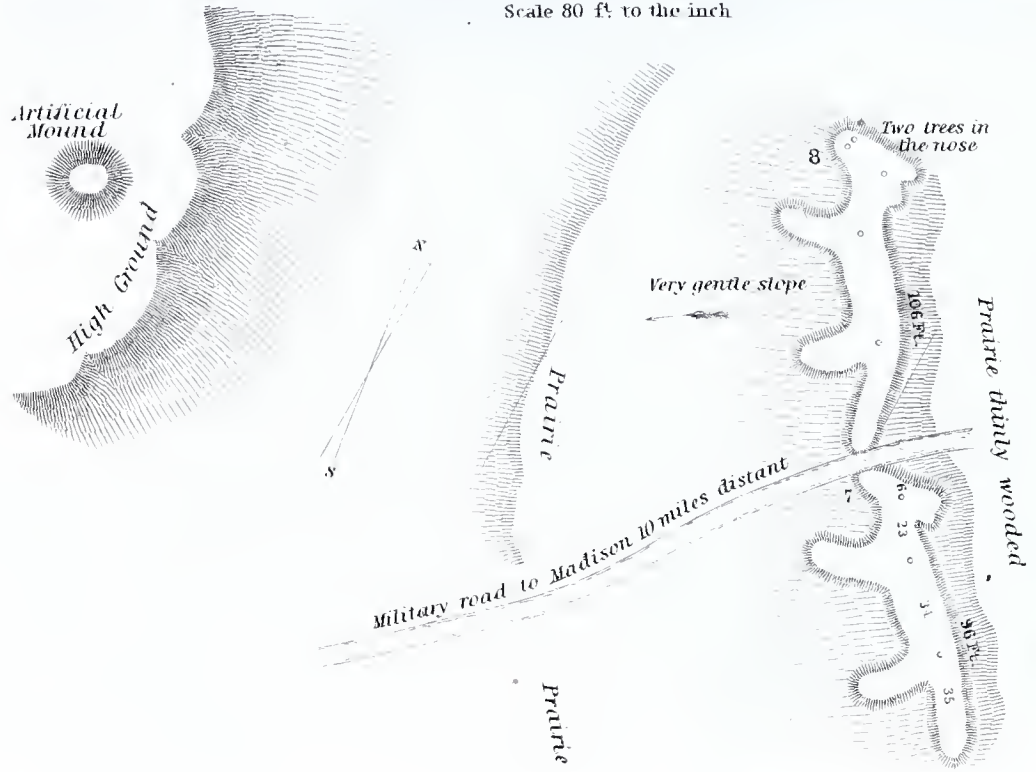
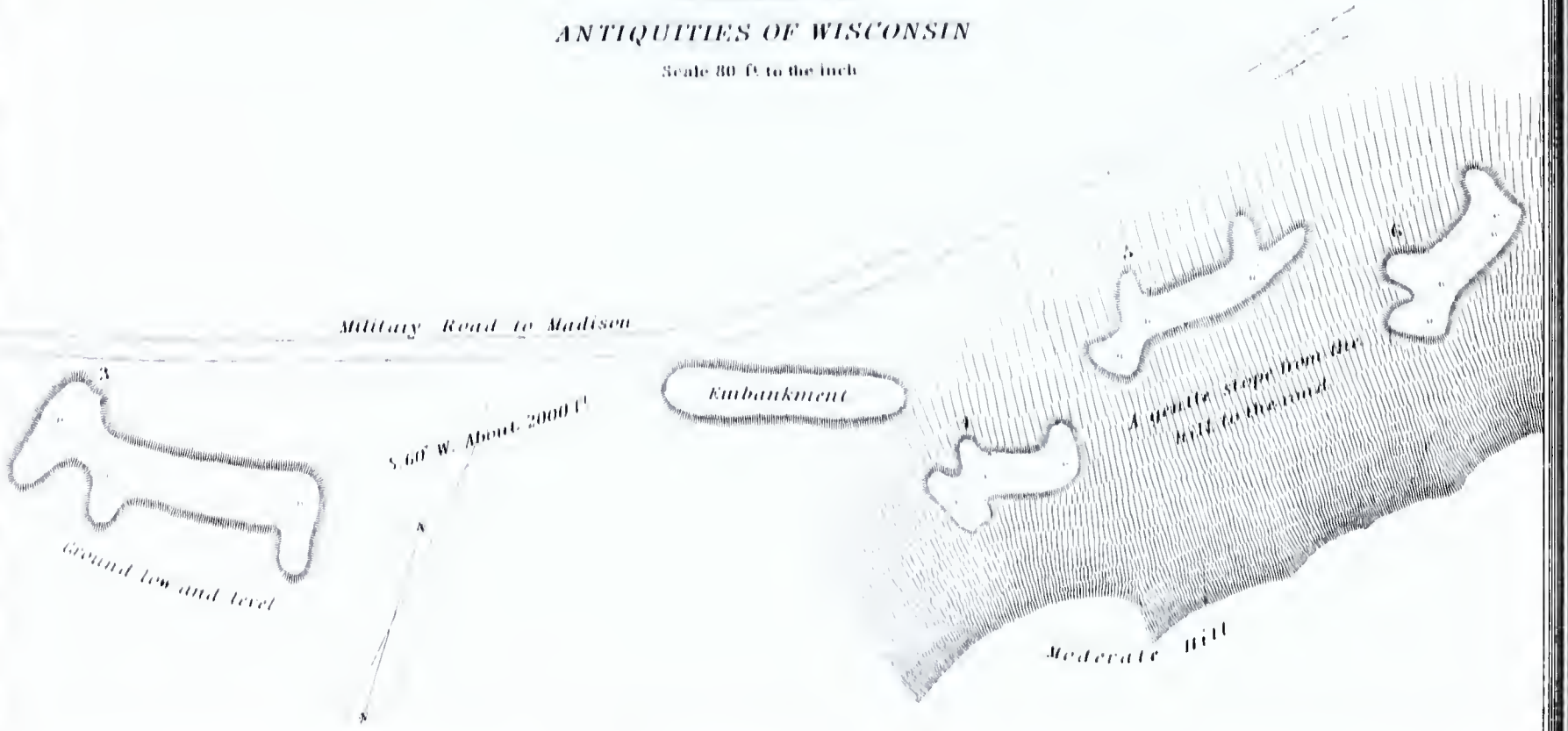


PLATE Nº 24.

ANTIQUITIES OF WISCONSIN

Scale 80 ft. to the inch



Mr. Taylor has represented the effigies of birds, and one of the human figure, as occurring here; and I am happy, with a full conviction of the general accuraey of his representations, to call the reader's attention to his interesting paper.

On one of the hills I saw an embankment exaetly in the form of the cross, as it is usually represented as the emblem of Christianity. Some of the surveyors brought in sketches of works in the form of birds with wings expanded; and I heard of others in the form of lizards and tortoises. From what I have seen, I should think it very probable that these forms are to be found. But, in order that their existence should exeite in the public that interest which, as relics of ancient history, they really possess, they should be so exactly surveyed and depieted that their representations can be relied upon with confidence. I objeet to the very careless and imperfect manner in whieh most of our antiquities have been examined, by which they have been rather guessed at than surveyed. Althongh I have given a pledge not to undertake to *make* animals of these figures, yet, to the eyes of all, except very sagaeious people, they will look very like animals; and the question will arise, what kinds of animals were intended to be represented? In the originals, the size is so great, and the outline more or less obscured by herbage and undershrubs, that the impression of an effigy is much less deeided than when the same is diminished and brought into one point of view, in which all the parts are under the eye at onee. A comparison of the difference of expression, form, and attitude, does not strike one at all in the originals, while it is very deeided in the diminished copies. Mr. Taylor suggests that those were intended to represent the buffalo, though he aeknowledges the representation to be imperfect, especially in wanting the "hump." It appears to me that the figures 1, 2, 3, and 6, might have been intended as effigies of the bear; the clumsy proportions, and want of the caudal appendage, appear like that animal. Figures 5, 7, and 8, have decidedly an expression of agility and fleetness. They may have been intended for the eougar, or Ameriean tiger—an animal still existing in that region. The only general disproportion to that animal is the length of the head.

I have thus, my dear sir, laid before you, as well as eircumstances would permit, the result of a few hours' very hard labor in the examination of the antiquities of Wisconsin, with the faint hope that, from some source or other, there may emanate an interest sufficient to cause an *accurate* and general survey and history of them to be imbodied and preserved. I know of no prospeetive volume which I should open with more interest than an *accurate* representation of all of our remaining earthwork antiquities.

VI.—TABLE OF METEOROLOGICAL OBSERVATIONS, TOGETHER WITH BAROMETRICAL OBSERVATIONS, MADE FOR DETERMINING ALTITUDES AND THICKNESS OF STRATA.

In the following record of observations, the external temperature is noted according to the seale of Fahrenheit; the barometer in Freneh millemetres; and the attached thermometer in the centigrade scale. The number immediately preeeding the *particular locality*, as "7th eneampment, Davenport," is the number of the station or encampment, corresponding with the numbers used for the same stations in the table of magnetical observations where the latitude and longitude of eaeh are noted. The number succeeding any particular place, as "hotel, 30 feet," is the approximate altitude in feet above the low-water mark of the nearest considerable stream.

Seventh encampment, Davenport.

Date.	Time.	Thermometer, Fahrenheit.	Wet bulb.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.						
Sept. 13	11 00 A. M.	–	–	756.1	18.5	River edge at Davenport.	
13	8 85 P. M.	58°	–	750.6	15	7th camp at Davenport.	
14	6 00 A. M.	55	–	745.3	13	Do.	
14	9 00 "	65	–	742.8	23.5	Hotel at Davenport, 30 feet.	Violent thunder shower.
14	2 30 P. M.	–	–	742.9	22	Ferry house, 13 feet.	The 14th has been cloudy and windy, with occasional glimpses of the sun, the wind being from the southwest, and the clouds rolling rapidly from the same quarter.
14	3 00 "	–	–	738 6	24	Hill top west of Davenport.	
14	3 32 "	–	–	752.7	25.5	Ferry house, 13 feet.	
14	7 00 "	–	–	742.7	24	Hotel, 30 feet.	
15	6 00 A. M.	66	–	744.0	20.5	Do.	Cloudy, gusty, wind from south and southwest.
15	9 00 "	63	–	746.7	19	Do.	
15	5 00 P. M.	63	–	749.5	22.5	River edge.	
16	1 30 A. M.	42	–	751.9	16.5	Hotel.	
16	5 30 "	42	–	751.2	13	Do.	
16	6 00 "	55	–	746.2	18.5	Do.	Cloudy, wind northwest, had been showery, with strong wind during the night.
16	11 30 "	–	–	748.9	17	Do.	
16	12 20 P. M.	–	–	749.9	18.5	Do.	Sun hazy, wind south, very gentle.
16	2 15 "	–	–	749.2	17	Do.	
16	6 00 "	–	–	749.7	16	Donaldson's coal mine.	
16	8 45 "	53		751.2	17	Hotel, 30 feet.	Clear and calm.
18	6 50 A. M.	43	–	751 2	13.5	Do.	Clear, slight fog.
18	11 00 "	66	–	751.5	18	Do.	Perfectly clear, wind southwest, gentle.
18	9 30 P. M.	63.5	–	750.1	22	Do.	Clear and calm.
19	5 50 A. M.	57	–	749.2	14	Do.	Clear, wind southwest, very gentle.
19	11 30 "	74	–	751.2	22	Do.	Thin calm clouds hazing the sun, wind southwest, gentle, but constant, and delightfully agreeable.
19	3 00 P. M.	78	–	749.7	23	Do.	
20	6 00 A. M.	58	–	750.6	22	Do.	Calm, clear, little fog on river.
20	7 30 "	–	–	751.4	19.5	Ferry house, 13 feet.	
20	7 45 "	–	–	750.8	19.5	Hotel.	

20	8	24	"	–	–	747.2	19.5	Prairie NW. of Davenport, and near Le Clere's NW. corner.
20	9	20	"	–	–	751.6	20.0	Ferry house.
20	4	00	P. M.	79	–	750.0	23.5	5 feet above low water of Miss.
20	4	15	"	–	–	748.4	23.5	Hill near the camp, 60 feet.
21	6	00	A. M.	66	59°	746.7	18.5	Camp 60 feet above low water.
21	8	40	"	72	63	747.2	22	Do.
21	11	45	"	–	–	745.6	28	Do.
21	12	00	M.	81.5	67	–	–	Do.
21	5	30	P. M.	–	–	743.5	25	Do.
21	5	45	"	–	–	744.7	25	5 feet above low water.
21	6	00	"	76	69	–	–	60 feet above low water.
21	6	33	"	–	–	744.0	23	Do.
21	8	33	"	–	–	744.1	24	Do.
21	9	00	"	70	66.5	–	–	Do.
21	12	00	"	69	60.5	–	–	Do.
22	3	00	A. M.	56	49.5	744.8	13	Do.
22	6	00	"	51	45.5	745.4	10.5	Do.
22	8	00	"	–	–	746.4	13.7	Do.
22	8	20	"	53	48.5	748.9	15.5	A river, 5 feet.
22	12	20	P. M.	63	–	745.4	19	Ravine, 6 miles S. of Lost Grove.

Flying clouds and gusty wind.
Clear until 10 o'clock, when commenced a high wind from the south, with some lightning.
Wind in strong gusts, breakers on the river.

A few drops of rain, a rainbow, clear in the west.
Wind nearly west, in interrupted breezes, clouds "fleecy," and rolling from the west in successive scrolls.

Perfectly clear, wind west, in gusts.
Do do.

Eighth encampment, Lost Grove.

22	4	00	P. M.	62.5	53.5	746.0	18.5	Camp.
22	6	00	"	56	–	745.6	15	- - - - - -
23	6	00	A. M.	34	–	745.1	8.25	Camp, Lost Grove.
23	12	00	M.	–	–	745.6	23	Do.
23	12	30	P. M.	71	–	743.8	19	Top of hill in Lost ve.
23	9	00	"	–	–	744.1	10	Camp, Lost Grove. Gro
24	6	00	A. M.	33	–	749.9	6.75	Do.
24	6	00	P. M.	54.5	–	743.5	12.5	Do.

Clear, wind west, subsiding.
Clear and calm.
Clear and calm, dew abundant.

Clear, moderate northwest wind.
Clear, calm, clouds, cirrus.
Has rained since 8 A. M.

Ninth encampment, Wapsipinecon river.

Date.	Time.	Thermometer, Fahrenheit.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Sept. 25	6 00 A. M.	45°	742.2	7.75	Camp.	Had become clear during the night, black clouds flying from the northwest.
25	12 00 M.	59	746.6	15	Do.	Wind northwest, blowing a gusty gale.
25	3 00 P. M.	61	747.1	16	Do.	Do.
25	6 00 "	–	748.8	10	Do.	Clear and calm.
26	12 30 A. M.	–	749.3	–	Do.	Clear, calm, and frosty.
26	6 00 "	33.5	749.2	10	Do.	Clear, calm, and frosty, and fog on river.
26	2 00 P. M.	–	749.3	12	Do.	Becoming cloudy.
26	6 00 "	–	–	–	Do.	Beginning to rain.
26	7 35 "	58	740.7	–	Do.	

Tenth encampment, natural wells on Wapsipinecon.

27	6 00 A. M.	41	743.4	5	Camp.	Rain had ceased at midnight.
27	10 00 "	47	749.3	12	4 feet above river.	Wind subsiding.
27	10 10 "	–	749.0	10	Camp.	Clear, gentle north wind.
27	12 00 M.	–	749.3	12	4 feet above river.	
27	12 20 P. M.	–	748.7	13	Camp.	
27	12 40 "	–	745.1	14	1st hill.	
27	1 00 "	–	745	13	2d hill.	
27	3 00 "	–	749.3	12	River again.	
28	6 00 A. M.	46	750.5	2.5	Camp.	Cloudy, calm.
28	2 15 P. M.	54.5	744.3	8.0	Hill 10 miles north of last encampment.	

Eleventh encampment, Elkford.

28	4 17 P. M.	–	743.4	7	Camp.	Cloudy, calm.
28	7 00 "	–	744.5	10	Do.	
29	6 00 A. M.	45.5	750.8	11	Do.	Clear, wind west, moderate.
29	2 00 P. M.	–	746.2	14.3	Hill near Brown's settlement.	

Twelfth encampment, Small mill.

29	4 00 P. M.	–	748.7	5	Camp.	
29	5 00 "	–	749.4	5	At the mill.	
30	6 00 A. M.	17.5	750.1	8	Camp.	Clear, frosty.
30	2 00 P. M.	50	749.8	15.15	Do.	Wind west, brisk.

Thirteenth encampment, bridge, Wapsipinecon river.

30	4 00 P. M.	53	749.9	15	Camp.	
Oct. 1	6 00 A. M.	37	747.5	26	Do.	
1	8 00 "	–	748.7	11	7 feet above water.	
1	8 30 "	–	744.7	11	Top of hill south of bridge.	
1	12 00 M.	–	740.4	23	Hill between Wapsipinecon and Makoqueta rivers.	
1	2 00 P. M.	–	745.1	25.5	Valley below the last.	

Fourteenth encampment, branch of Makoqueta.

1	4 45 P. M.	–	745.0	24.5	Camp.	Clear, wind west, gentle air, smoky.
1	6 00 "	62	745.0	16	Do.	
2	6 00 A. M.	42	743.8	5.6	Do.	Calm, clear, a few light clouds.

Fifteenth encampment, mills on Makoqueta.

Date.	Time.	Thermometer, Fahrenheit.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Oct. 3	6 00 A. M.	46°	744.3	8.5	Camp.	Cloudless and smoky. Prairies on fire.
3	6 .20 "	–	745.5	9	Water's edge.	
3	2 00 P. M.	88	–	–	- - - - - -	Clear, wind west, a little smoky.

Sixteenth encampment, Cheney's.

3	9 15 P. M.	60	738.3	15	Camp.	Clear, slight haze, meteors numerous.
4	6 00 A. M.	–	737.4	16	Do.	
4	8 00 "	–	745.2	26	Farmers' creek.	
4	9 30 "	–	740.5	26	Round Grove.	

Seventeenth encampment, Farmers' creek.

4	6 00 P. M.	–	742.2	23	Camp.	Clear, wind SW. ; gentle, dappled clouds in NW.
5	6 00 A. M.	63.5	–	1	Do.	Cloudy, had been lightning in the horizon all the night ;
5	8 00 "	–	740.9	19	Do.	showery, thunder.
5	3 10 P. M.	66	749.9	19.5	Do.	
5	5 00 "	–	740.5	23	Top Round Grove.	Cloudy, windy, wind from south with showers, stars seen
5	5 35 "	–	744.8	22	Farmers' creek, 6 feet.	occasionally, thunder and lightning at a distance.
5	6 00 "	–	744.1	21	Camp, 6 feet.	
5	9 00 "	–	738.9	20.5	Do.	
6	7 00 A. M.	62.6	739.8	17	Do.	Cloudy, rainy, windy, wind violent during the night,
6	2 00 P. M.	77	743.0	26	Do.	clear since 8 A. M., wind south in strong gusts.
7	6 00 A. M.	–	745.0	17.3	Do.	Cloudy, wind south, gentle.
7	9 00 "	–	745.0	20	Do.	
7	9 30 "	–	730.8	21	A hill, 2 miles north of camp.	

Eighteenth encampment, Whitewater rivulet.

7	9 00 P. M.	66	742.2	20.5	Camp.	Showery, strong south wind.
8	6 00 A. M.	65	740.5	18.66	Do.	Cloudy, wind south.
8	2 00 P. M.		740.3	25	4 feet above Whitewater rivulet.	

Nineteenth encampment.

8	5 25 P. M.	67.3	738.3	19.6	16 feet above water.	Wind south, rainy.
9	6 00 A. M.	66	741.0	19	Camp.	
9	9 00 "	–	736.5	20	Hill-top 2 miles west of camp.	Rainy.

Twentieth encampment, North fork Makoqueta.

9	3 25 P. M.	62.4	740.9	20	Camp.	Cloudy, wind northwesterly.
9	4 35 "	–	741.0	18	12 feet above water	
9	4 40 "	–	740.5	18	Camp.	
10	6 45 A. M.	54.5	741.4	12.5	Do.	Wind east, strong, misty, fog running low.
10	2 00 P. M.	57.2	743.1	14	Do.	Incessant rain from the east.
10	9 00 "	–	742.7	16	Do.	Rainy, strong northeast wind.
11	7 00 A. M.	53	740 0	12.5	Do.	Rainy, gentle northeast wind.

Twenty-first encampment, Sherwood's.

11	8 00 P. M.	53	741.1	14.5	Camp.	Wind north, clouds crossing the surface of prairie.
11	10 00 "	50	–	–	Do.	Wind north again.
12	6 15 A. M.	49	730.3	10	Do.	Cloudy and misty, wind variable.
12	2 00 P. M.	57	–	–	Prairie 4 miles west of Dubuque.	

Twenty-second encampment, Dubuque.

Date	Time.	Thermometer, Fahrenheit.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Oct. 12	8 00 P. M.	–	745.5	18	Mr. Dwelle's.	Cloudy, has been misty during the day.
13	6 00 A. M.	56°	748.3	14.8	Do.	Cloudy, but clear of mist.
13	4 30 P. M.	–	745.6	16	Dubuque's grave.	
13	5 00 "	–	750	16	7 feet above water.	
13	5 20 "	–	743.1	18	A hill south of Dubuque.	
13	11 00 "	52.5	–	–	- - - - -	Clear, with an aurora with streamers 30° high, strong south wind.
13	12 00 "	–	747.9	15.5	Mr. Dwelle's.	
14	6 25 A. M.	49	748.5	–	Do.	Clear, wind southwardly.
14	8 05 "	–	743 8	12	Dougherty's mine.	
14	9 30 P. M.	–	744 8	18.5	Mr. Dwelle's.	Clear, calm.
15	6 00 A. M.	–	748.8	16.5	Do.	Do.
15	9 47 "	–	751.4	21	10 feet above the river.	
15	10 00 "	–	743.4	22	Hill top 1 mile west of Dubuque.	
15	12 00 M.	–	738.1	24	Hill 7 milles west of Dubuque.	
15	12 30 P. M.	–	736.3	24	Heights of Little Makoqueta, 8 miles west of Dubuque.	
15	1 30 "	–	747.9	26.5	Channel of Little Makoqueta.	
15	2 25 "	–	736.3	24	Heights on north side of Little Makoqueta.	
15	3 30 "	–	746.8	26	Channel again.	
15	5 00 "	–	735.1	22.5	At the heights on south side again.	
15	8 10 "	–	748.9	19	10 feet above the river again.	
16	6 00 A. M.	60.5	747.1	18	Mr. Dwelle's.	
16	12 34 P. M.	–	747.4	22	Illinois, opposite Dubuque, 6 feet above water.	
16	2 54 "	–	732.1	28	Top of Sinsinewa Mound.	
16	3 30 "	–	738.0	26	Plain 1 mile west of Sinsinewa Mound.	
16	5 00 "	–	744.2	27	Menomonie rivulet.	

16	6 45 "	–	746.4	25	Ferry house opposite Dubuque.	
17	6 15 A. M.	64.5	749.5	20	River edge, 6 feet above water.	
17	6 30 "	–	748.8	18	Ferry house again.	
17	2 45 P. M.	84	746.7	–	Mr. Dwelle's.	Strong south wind, smoky.

Twenty-third encampment, on Little Makoqueta.

18	6 30 A. M.	53.5	749.2	13	Camp.	Cloudy, gentle northwest wind.
18	7 30 "	–	749.1	13	Do.	
18	9 15 "	–	737.1	14	The hill 7 miles west of Dubuque.	
18	9 50 "	–	736.2	14	The heights of Little Makoqueta, 8 miles west of Dubuque.	
18	10 15 "	–	748.1	14	The channel of south fork of Little Makoqueta.	
18	10 48 "	–	737.2	15	The heights on north side of the above fork.	
18	11 14 "	–	748.8	15	Channel again.	
18	1 40 P. M.	53.5	750.5	13	Camp again.	Cloudy, wind north, and misty.
18	3 15 "	–	743.2	11.5	Do.	
18	5 05 "	–	752.5	11	Do.	
18	6 00 "	–	751.4	14	Mr. Dwelle's.	
19	6 30 A. M.	–	756.4	11.5	Do.	Wind northwest, clouds defined, not misty.
19	2 30 P. M.	–	758.3	9	Do.	
19	6 00 "	–	758.8	7	Camp on Little Makoqueta.	
19	9 00 "	35	–	–	Do.	Clear, wind variable.
20	6 30 A. M.	36.3	–	–	Do.	
20	9 30 "	–	760.9	6	Do.	Clear, wind northeast, strong.
20	1 00 P. M.	–	758.5	10	Do.	
20	3 10 "	–	740.9	10	Top of Sherald's Mound.	

Twenty-fourth encampment, near Sherald's Mound.

20	8 25 P. M.	–	746.7	9.5	Camp.	
21	6 20 A. M.	30	744.4	.1	Do.	Clear, calm, frosty.
21	1 30 P. M.	–	737.5	13	Mound 4 miles northwest of Sherald's.	

Twenty-fifth encampment, log house, head branch of Makoqueta.

Date.	Time.	Thermometer, Fahrenheit.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Oct. 21	7 15 P. M.	53°	738.5	15.7	Camp.	
22	6 15 A. M.	48	737.1	11	Do.	
22	10 00 "	–	738.6	15	3 miles south of Turkey river.	
22	11 55 "	–	750.8	20	Little Turkey river.	

Twenty-sixth encampment, Turkey river, (Winchester.)

22	8 00 P. M.	–	749.1	20.5	Camp.	Wind west.
23	6 30 A. M.	62	747.4	16	Do.	Cloudy, smoky, showery, calm.
23	12 20 P. M.	–	750.	21	Do.	
23	1 00 "	–	744.9	22	Top of hill north side of Turkey river.	

Twenty-seventh encampment, near Dr. Andrews's.

23	7 45 P. M.	–	739.8	18	Dr. Andrews's.	Cloudy, smoky, gentle west wind.
24	6 30 A. M.	50	736.4	12	Camp.	Had been showers in the night, broken clouds from the south, wind east, gentle.
24	8 10 "	–	734.9	12.5	Dr. Andrews's house.	
24	8 25 "	–	737.1	12.5	Dr. Andrews's spring.	
24	12 00 M.	–	731.8	18	Iron ore near Farmersburg.	Rainy.
24	12 30 P. M.	–	730.8	20	Hill east of Farmersburg, on road to Prairie du Chien.	
24	2 30 "	–	733.5	22.5	Top of sandstone, Prairie du Chien ferry.	

Twenty-eighth encampment, opposite Prairie du Chien.

24	3 20 P. M.	–	742.7	22	River edge.	
24	4 20 "	–	739.8	21	White limestone.	
24	4 45 "	–	735.0	20	Bluff near the ferry, just below it.	
24	5 50 "	–	741.8	20	Camp 10 feet above river.	
24	8 30 "	69.6	–	–	Do.	Showers, thunder and lightning.
25	6 30 A. M.	46	744.5	7.2	Do.	Clear, wind west.
25	1 13 P. M.	–	745.1	18	Do.	
25	1 55 "	–	735.3	19.5	Sandstone.	
25	2 25 "	–	732.5	19.5	Hill top near the sandstone.	
25	3 00 "	–	744.5	18.5	River.	(Crossed the river to Prairie du Chien.)

Twenty-ninth encampment, Prairie du Chien.

26	6 30 A. M.	63.6	739.3	17.1	River edge.	Clear, had been showers, with thunder.
26	9 00 "	–	738.5	20	Tent.	Strong southwest winds, flying clouds.
26	10 00 "	–	735.0	20	"1st bench" of hill.	During the time of these observations, which were made to ascertain the altitudes and the thickness of strata, the wind was blowing a very violent gale, and the barometer was undergoing rapid fluctuations.
26	10 30 "	–	730.6	20	Top of sandstone.	
26	11 00 "	–	726.0	20	Top of hill.	
26	12 00 M.	–	728.0	18	Bottom of cliff stone.	
26	12 10 P. M.	–	731.7	13	Top of sandstone again.	
26	12 35 "	–	735.7	18	Quarry stone.	
26	1 00 "	–	741.2	17	Camp 28 feet above river.	
26	1 30 "	–	742.3	17	River edge.	
26	3 00 "	–	728.8	15.5	Hill top again.	
26	3 25 "	–	730.9	14.5	Cliff again.	
26	4 45 "	–	744.3	15	Camp again.	
27	6 30 A. M.	51.5	744.5	11	Camp.	Raining, wind north, moderate.
27	12 00 M.	–	744.8	16.5	Mr. Nicollet's room.	
27	12 00 M.	–	739.7	16.5	Mr. Nicollet's room, by Mr. Nicollet's barometer.	
27	2 34 P. M.	–	744.9	11	Wisconsin river.	
27	5 00 "	–	736.0	10	Top of sandstone, 4 miles southeast of Wisconsin ferry.	

Thirtieth encampment, Trout brook.

Date.	Time.	Thermometer, Fahrenheit.	Barometer, in millimetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Oct. 27	8 45 P. M.	54°	743.1	12	Camp.	
28	6 30 A. M.	39.70	746.0	4.5	Do.	Clear, calm.
28	7 09 "	–	740 7	8	Top of sandstone.	Strong western gale, storm clouds flying.
28	8 12 "	–	742.5	8	Road.	
28	8 30 "	–	736.6	7	Hill top, head of Trout brook.	
28	12 00 M.	50	736.4	12.5	Top of sandstone, 15 miles east of last encampment, (490 feet.)	
28	12 50 P. M.	50	–	–	– – – – –	
28	4 20 "	–	739.6	10	Top of sandstone, near Parish's, (479 feet.)	Wind west, clear, with flying clouds.

Thirty-first encampment, Parish's furnace.

28	5 50 P. M.	–	739.1	7	Camp.	
29	6 00 A. M.	35	738.1	1.5	Do.	
29	6 34 "	–	738.6	2	Top of sandstone at Parish's furnace.	
29	8 15 "	–	739.6	8	Camp.	
29	8 44 "	–	735.3	10	Height of prairie.	
29	12 38 P. M.	59	729.3	16	Road to Blue Mounds.	Clear, wind south.

29	8 43 P. M.	49.5	731.3	11	Camp.	Cloudy, brisk south wind.
30	6 00 A. M.	43	725.4	5.8	Do.	Had been a sprinkle of rain, clear, wind southwest.
30	7 30 "	–	725.5	6.2	Do.	Altitude of mound seen from camp, 4° 38′.
30	7 45 "	–	718.2	6.5	Lowest, large masses of hornstone on the side of the mound.	
30	8 00 "	–	709.2	6.5	Top of Blue Mound.	
30	9 17 "	–	709.4	6	At western brow of mound.	
30	10 03 "	–	721.7	7	Limestone.	
30	10 30 "	–	725.4	7	Camp	Wind northwest, showers.
30	3 00 P. M.	–	725.5	7	Do.	
30	8 00 "	44.5	–	–	Do.	Wind northwest, very strong.
31	6 31 A. M.	38.3	733.7	4	Do.	Cloudy, wind northwest, gentle.
31	7 30 "	–	734.4	5	Do.	Commenced a journey to the river at Arena.
31	8 06 "	–	731.4	5	Top of prairie.	
31	8 25 "	–	729.8	5	Dividing ridge.	Limestone here.
31	9 12 "	–	734.6	5	Top of sandstone.	
31	10 00 "	–	743.1	7.5	Ravine.	These observations made for the sole purpose of determining the height of Blue Mound above Wisconsin river. The result was, that the altitude is within a few inches of 1,000 feet.
31	11 02 "	–	746.2	10	Alluvial plain of the river.	
31	12 00 M.	–	746.9	10	Wisconsin river.	
31	1 10 P. M.	–	746 3	12	Alluvial plain again.	
31	1 30 "	–	741.8	11	Top of lower sandstone.	
31	2 20 "	–	746.3	10	Alluvial plain again.	
31	3 15 "	–	743.5	11	Ravine again.	
31	4 00 "	–	734.8	10	Top of sandstone again.	
31	4 20 "	–	731.7	10	Ridge.	
31	5 00 "	–	734.3	3	Camp again.	
Nov. 1	6 30 A. M.	35.5	735.1	5	Do.	
1	7 15 "	–	735.2	7	Do.	
1	10 05 "	–	736.4	6	Sandstone, 7 miles east of mounds.	
1	1 15 P. M.	–	735.8	6.6	Prairie, 10 miles west of Madison.	

Thirty-third encampment, Madison, Wisconsin.

Date.	Time.	Thermometer, Fahrenheit.	Barometer, in millemetres.	Attached thermometer, centigrade.	Particular locality.	General remarks.
1839.	h. m.					
Nov. 1	3 47 P. M.	–	742.0	7	Lake at Madison.	
1	5 00 "	–	740.7	7	Camp.	
1	6 10 "	–	739 2	1.5	Do.	
2	12 05 "	–	740.9	8.5	4th lake.	
2	12 40 "	–	738.6	8 5	Capitol of Wisconsin.	
2	2 30 "	–	735.2	7	Hill 3 miles west of capitol.	
2	3 00 "	–	739.4	8.3	16 feet above the lake.	

Thirty-fourth encampment, near a sandstone bluff.

3	9 45 A. M.	–	727.3	7	Ridge 12 miles west of Madison.	
3	11 45 "	48°	730.5	9	At the two "effigies."	
3	12 20 P. M.	–	728.6	7	Ridge again.	
3	1 10 "	–	734.3	7.5	Camp.	
3	4 30 "	–	733.2	6.5	Do.	Becoming clear, wind northeast, gentle.
4	6 30 A. M.	38.3	738.8	3.5	Do.	An aurora during the night of the 3d.
4	11 00 "	–	727.7	8.5	Do.	Very strong east wind, clear and cloudy, struck the tent.
4	11 50 "	–	724.0	9.5	Sandstone.	
4	2 30 P. M.	–	720.5	8.5	Old camp at Blue Mounds.	

Thirty-fifth encampment, Skinner's.

4	4 25 P. M.	–	720.7	7	Ravine near Skinner's, where we encamped. Screened a little from a violent storm of rain and wind.	
5	6 30 A. M.	–	713.0	9	Camp.	
5	7 00 "	–	711.2	9	Top of sandstone, at Skinner's.	

Thirty-sixth encampment, Mineral Point.

6	6 30 A. M.	41	720.0	6	Camp.	Violent north wind, with rain. Clouds flying wildly to the south.
6	2 07 P. M.	–	727.6	9	Do.	
7	6 30 A. M.	25	–	–	Do.	Clear, calm, frosty, ground frozen a little.
7	9 00 "	–	734.	10	Do.	Clear, wind northwest.

Thirty-seventh encampment.

8	6 30 A. M.	25	735.1	1	7 miles southwest of Mineral Point.	Clear, frosty, calm.
8	9 00 "	–	728.2	3	Top of Platte Mound.	
8	6 15 P. M.	–	744.5	4	4 miles north of Galena.	
9	6 30 A. M.	–	–	–	- - - - -	Clear, frosty, calm.

The foregoing table is, as appears, not quite complete in its meteorological department; the external temperature being too often neglected in consequence of engagements at the proper hours in other duties. I was sometimes in the midst of a series of magnetical or barometrical observations, which it was impossible to leave until they were finished; hence, the observations of the true temperature at midday were often sacrificed.

It will be seen that the barometrical observations have been the chief object. The observations from which have been deduced the altitudes and thickness of strata are presented in the foregoing table, in such a manner that persons qualified for the task may review my labors in that department, and, if they choose, making the more particular equations for the differences of temperature, arrive at the heights with greater precision.

It will be seen, also, by the "observations," that, notwithstanding some publications to the contrary, the climate of this region is no less changeable than that of other places in the United States in the corresponding latitudes; at least so it appears during the short period to which my observations were confined. Thunder showers and strong gusty winds were of frequent occurrence. A fine breeze undoubtedly sweeps refreshingly over the open prairies during the summer months; but during autumn and winter I apprehend the breeze is often exalted into uncomfortably bleak and gusty gales.

During this tour I had three opportunities of observing instances of the connexion which probably exists between particular meteoric phenomena (such as aurora lights and "shooting stars") and atmospheric changes.

1. The aurora of September 3d was followed within twenty-four hours by a rain storm.

2. The display of shooting stars and fire balls seen October 3d, at Cheney's, was followed by a whole week of winds and rain.

3. On the night of November 3d, while encamped on the military road, an aurora was observed, which exhibited the following appearances: An arch of light, about fifty degrees in length, extended along the northern horizon, having its middle or north point about eight degrees high. The segment of the firmament included between it and the visible horizon was a shade darker than the sky above it; and several meteors or shooting stars were seen in various parts of the heavens.

November 4th: The sun was visible, but muffled in mist, and a strong wind from the southeast. About 4 o'clock it began to rain, and continued copiously, with a violent wind, during the night. On the morning of the 5th it was nearly calm, but a little showery. About 10 o'clock, as we were travelling towards Mineral Point, a strong wind rose from the northwest, and drove a cold mist and rain almost horizontally into our vehicle, drenching us completely all day as we traversed the high and open prairies. My limbs became so benumbed that they were stiffened so much that I was unable to move until I had made several efforts. An indisposition succeeded, which for ten days disqualified me for active duty, and prevented me entirely from making the intended investigations at Galena.

Until writing this paragraph, I did not notice that these meteors occurred on the third day of three successive months.

An aurora seen from Dubuque, with streamers thirty degrees high, on October 13, was not followed by any peculiar atmospheric change.

Observations to show what reliance may be placed on the indications of a stationary barometer, one hundred or two hundred miles distant, when used for determining altitudes by comparative observations, made by means of another, at the given place.

Dr. Engelmann, of St. Louis, has kindly favored me with a copy of his record of observations, made at St. Louis, about fifty feet above low water of the Mississippi, during my tour in Iowa and Wisconsin. Dr. Engelmann's barometer is well constructed, and agrees with my own within a small fraction of a millemetre. The following results will show that no dependence can be placed on a single observation made at so great a distance as Davenport from St. Louis, especially in our latitude, and in the autumnal season.

Three observations, nearly simultaneous, at Dr. Engelmann's office in St. Louis, and at my room in the hotel at Davenport, September 16, give the following differences of altitudes:

	Feet.
First	310
Second	158
Third	379
	3)847
Mean	282

Six observations made at the same places on the 18th, 19th, and 20th, give the following results:

	Feet.
First	189
Second	152
Third	231
Fourth	207
Fifth	238
Sixth	207
	6)1,224
Mean	204

On account of the St. Louis barometer being twenty feet higher from the water than that at Davenport, we must add twenty feet to the above: making 224 feet the result of the observations, as indicative of the fall of the Mississippi river from Rock island to St. Louis. The distance being 337 miles, the average fall per mile would be 0.664 foot, or a little less than 8 inches; this is probably greater than the true fall.

The above six observations were made at a very favorable time, the weather being calm at both places, and the barometer changing very little during the whole period; but the results are not such as to inspire much confidence in atmospheric levelling, connected by corresponding observations made at points so remote from each other, unless the mean of a long series be obtained. Indeed, the known principles of barometric action would lead us to anticipate such a result.

M. Nicollet happening to be at Prairie du Chien at the time I was proceeding up the Wisconsin, and our barometers having been compared, his observations at that place were proper stationary or basal observations to my simultaneous ones, at various places, differing in altitude. At my request, he has obligingly furnished me with a copy of them. By a careful comparison of the two sets of observations, some of the heights indicated are as follws :

	Feet above the Mississippi.
Top of the sandstone, about 20 miles east of the mouth of Wisconsin river	490
Top of the sandstone at Parish's, 16 miles farther east	480
Top of Blue Mound above Mississippi at Prairie du Chien	1,414

There is undoubtedly some error in this last result ; as I am quite certain that the altitude of the Blue Mound above the waters of the Wisconsin, at Arena, is only 1,000 feet, and the fall of the Wisconsin from that point to its mouth is not over 50 feet.

M. Nicollet has also favored me with the latitudes and longitudes of St. Louis and Prairie du Chien, as determined by his own observations, as follows :

St. Louis : Longitude 90° 15′ 39″.
Latitude 38 37 28.

In latitude, the above coincides nearly with that which I have assumed in my magnetical chart ; but in longitude, there is a difference of several miles, as seen below :

Longitude of St. Louis, according to M. Nicollet	90°	15′	39″
Longitude assumed in my chart, according to "Major Long's expedition"	90	02	15
Difference		13	24
Longitude of Prairie du Chien, according to M. Nicollet	91°	09′	19′
Longitude assumed on the authority of "Long's expedition"	90	52	30
Difference		16	49

Besides the above favors received from Dr. Engelmann and M. Nicollet, it is with pleasure that I acknowledge the uniform kind treatment which I received from the inhabitants throughout the whole of our journey.

I am under special obligations to Mr. Dwelle, the first clerk in the land office at Dubuque, for numerous substantial favors while in that place, and for a variation chart transmitted to me since my return. In Dubuque, we were also indebted to Mr. John Smith and Mr. Dougherty for facilities and assistance in descending into the mines, for the purpose of making my magnetical observations.

Above all, my dear sir, I feel under obligations to yourself for inviting me to participate in a pursuit so congenial to our feelings and to our former studies, and, also, for the facilities promptly afforded in my investigations.

Compelled, as you were, to raise a corps for an extraordinary purpose, n so short a period, it was impossible that every subordinate should be ound to be equally qualified or equally willing to discharge his duty ac-

tively and faithfully; yet, as a whole, so far as it came under my observation, I bear my willing testimony to the industry and efficiency of the corps.

The heavy responsibilities which you assumed, producing the double advantage of economy to the public treasury and to the individuals employed, give you a claim to acknowledgments from every party interested in the expedition.

All of which is respectfully submitted, by your obliged friend and humble servant,

JOHN LOCKE.

No. VI.

[I invite attention to the following brief report by one of my sub-agents, an intelligent practical land surveyor of much experience and long residence in the West, to whose quick observation and intimate knowledge of his profession I am indebted for valuable assistance in the conduct of the expedition, particularly in accurately determining the exact localities of our mineral discoveries.—D. D. O.]

REPORT ON THE TIMBER, SOIL, AND PRODUCTIVENESS OF THE MINERAL DISTRICT: BY E. PHILLIPS, SUB-AGENT.

SIR: In conformity to your request, I hereby submit, for your consideration, the following report on the timber, soil, and productiveness of the district of mineral lands of the United States, situated in the Territories of Iowa and Wisconsin, and in the State of Illinois.

As a whole, this tract is poorly timbered. The proportion of timber is not more than a sixth or eighth of the whole, and, in general, it is of an inferior quality for the use of the farmer or mechanic.

In the southern portion of the tract, as far north as the Wapsipinecon, timber is scarce; the country principally prairie, with portions of scattering stunted timber, mostly oak, called by the inhabitants "oak openings." There are, however, some pretty good groves on the Mississippi, above Parkhurst, consisting principally of (quercus alba) white oak and (quercus macrocarpa) burr oak; and of several kinds of hickory, (inglans squamosa) shell-bark hickory, (inglans tomentosa) white hickory, &c.

On the Red Cedar river there are also several good groves of the above-named kinds of timber, with the addition of the (tilia alba) white linn, or, as it is sometimes called, basswood, which is quite conspicuous; (inglans nigra and inglans cathartica) black and white walnut also abound.

There is a belt of timber, generally of good quality, along the Wapsipinecon river and its branches; among which, the (quercus palustris) pin oak is abundant; the (quercus coccinea) scarlet oak is also found, and the (populus tremiloides) American aspen is common. Near this river, the (juniperus virginiana) red cedar also makes its appearance, and is common on the cliffs throughout the whole of the mineral district on both sides of the Mississippi. From the Wapsipinecon to the Big Makoqueta, the country is generally prairie. On the Big Makoqueta, like the Wapsipinecon, there is usually a belt of timber.

In the forks of the Makoqueta is found decidedly the best body of timber in the Dubuque district;* it covers several townships. This timber is

* In these timbered lands, we find greater indications of iron ore than in any other part of the Dubuque district; water power is also convenient and abundant.

of a good quality, consisting of several kinds of oaks and hickories, black and white walnut, ash, and sugar maple, (acer saccharinum;) from the last-named tree, considerable quantities of sugar have already been made.

From the Makoqueta to Turkey river, the country is open. Turkey river and its branches afford belts of timber of a tolerably good quality. Near the mouth of Turkey river is a small forest of lofty timber.

North of Turkey, as far as the mouth of Yellow river, we find in general prairie, except on the bottom lands of the Mississippi, on both sides of the river, which, as well as its islands, are covered with good timber, such as oak, sycamore, maple, &c.

The upper part of the mineral district in Wisconsin, about twenty miles south of the Wisconsin river, is thinly covered with timber, or what is called "openings." The timber is principally burr oak, and is very scrubby. Pines are occasionally met with on the cliffs along the small streams. In the neighborhood of the Four Lakes, and for several miles west and northwest, burr oak is almost the only timber to be met with. South of the principal dividing ridge, on which the military road runs, the country is mostly prairie, except on the streams, where we generally find a belt of timber.

The country on the Peccatonnica river, however, affords the greatest supply and the best timber of any portion of the mineral district in Wisconsin. The growth is chiefly white, black, pin, and scarlet oak.

The portion of the mineral district which lies in Illinois is also very deficient in timber; but, where it occurs, it is usually of a much better quality than that of Wisconsin.

The timber in the whole mineral district, on both sides of the Mississippi, grows in those situations which are least exposed to fire, and to the blasts of wind which sweep over the extensive prairies. That currents of air have a great effect in stunting the growth of trees, seems proven by the fact that trees in similar soils, when sheltered by the hills, are much higher than those which are in exposed situations. The annual fires, which have undoubtedly been kept up by the aborigines for ages past, have also, no doubt, contributed to keep open our vast Western prairies; for those parts of the Western country which were originally prairie, and where the fires have been kept out for twenty years or more, are now covered with thick groves of small trees. Such places are numerous in the southeastern part of Illinois.

The American aspen, in the whole district of mineral lands, seems to be the pioneer tree which first invades the prairies. In many places we see copses of this tree in the broad prairie, like little islands in a vast lake. And almost every where in the prairies, we see little shoots of it of one year's growth, which would soon be trees were it not for the annual fires. When once the prairie sward has been broken by this kind of tree, others come in, one after another; the prairie soon changes to the thicket; and, in a few years, it becomes the vast wilderness, "the boundless contiguity of shade."

The soil in the prairies throughout the district of mineral lands, where it is level enough to be cultivated, has an unusually black appearance, indicating a large proportion of decomposed vegetable matter.

This black mould is often four or five feet deep. In the timbered land, the soil is not so black, nor, from appearance, so productive; but, so far as

I have been able to ascertain, its productiveness seems to be equal to that of the blacker soil of the neighboring prairie.

The sub-soil of the district presents every variety of sand, clay, marl, &c., dependent on its geological position.

Owing to its northern latitude, it cannot be expected that Iowa and Wisconsin can produce as good Indian corn as Indiana, Ohio, and Kentucky; but it produces generally better corn than lands in the same latitude east of the lakes.

Wheat grows well when not destroyed by winter frosts; to these it is, however, more than usually exposed. Owing to the openness of the country, the snow is often blown off, leaving the unprotected wheat exposed to the wintry blast.

The crops of oats and potatoes raised in this district are equal to any in the United States. The soil and climate are also well adapted to the growth of grasses. Wild grasses grow luxuriantly, and cultivated grasses succeed admirably, so far as they have been tried.

All which is respectfully submitted.

EBENEZER PHILLIPS,
Sub-agent.

DAVID DALE OWEN, M. D.,
Principal Agent to explore the Mineral Lands of the U. S.